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The Largest Traveling Crane.

On this and succeeding pages we present engravings made from working drawings of what is at the present time, we believe, the largest crane of its type in existence. It was designed and built by the Morgan Engineering Company, of Alliance, Ohio, for the U. S. Navy Department, and is to be set up in the twelve-inch gun shop at the Washington Navy Yard. The crane is nominally of 110 gross tons capacity, and it is therefore called the one hundred and ten ton crane, though it is actually calculated to lift and carry 150 net tons, or 300,000 pounds. The tops of the supporting girders are 40 feet from the floor, and the crane rests upon two trucks, one at each end of the bridge, each truck having eight wheels upon which the load is equalized in such a way that each wheel bears an equal portion of the load at all times. Two bearing rails are on top of each supporting girder, the distance from center to center of the inside rails being 59 feet 2 inches. The specifications required that the crane should have an effective lift of 40 feet, and that the bridge should consist of two girders of wrought-iron or mild steel, of such cross-section, depth and construction, as to limit the fiber stress in the upper or compression member of each girder to a maximum of 7,500 pounds per square inch, and in the lower or tension member to 8,000 pounds per square inch of net section, when carrying the full load of 246,400 pounds at the center of the bridge, increased by the entire weight of the bridge, trolley and connected parts.

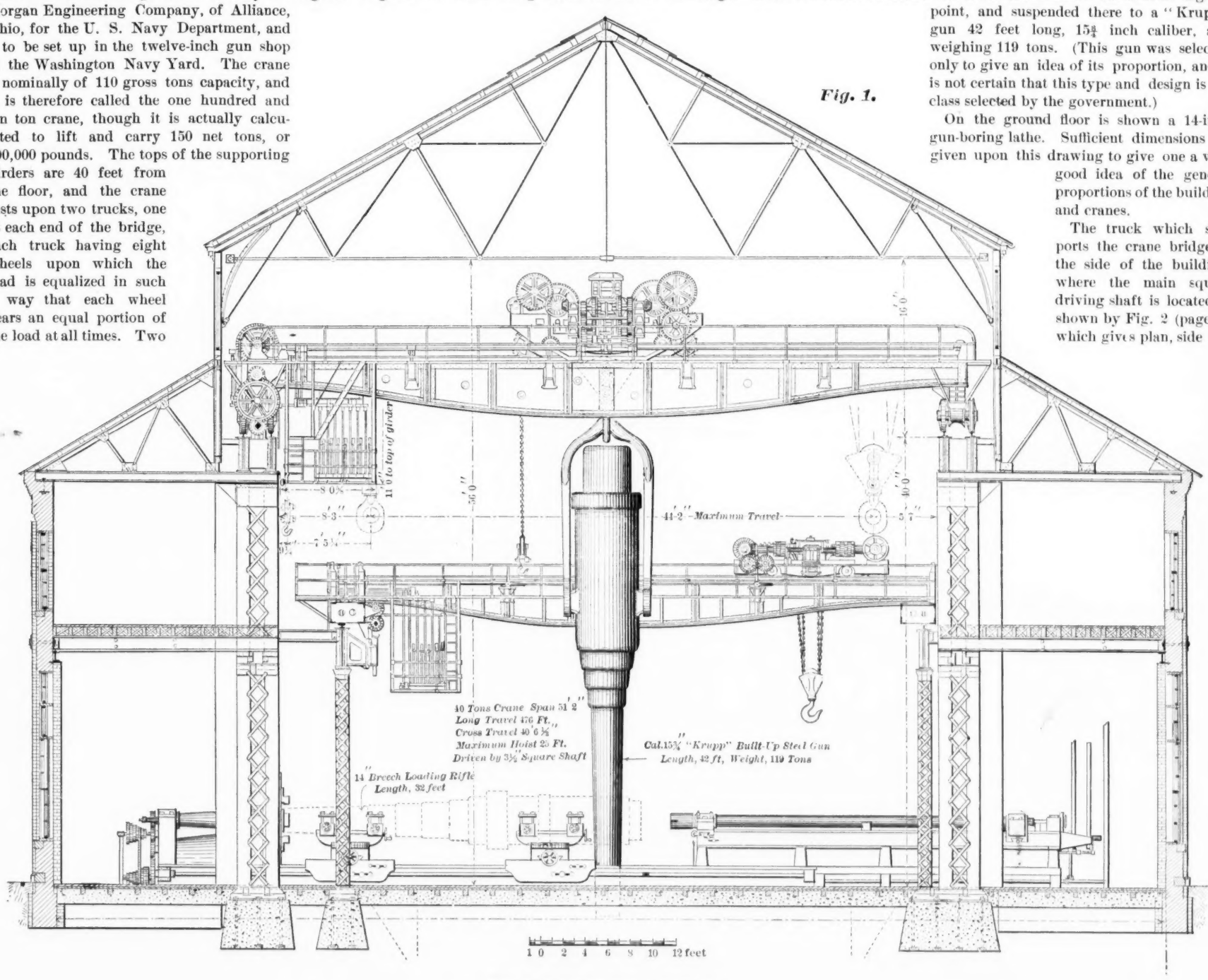
There are four speeds for the main hoist—1, 2, 4 and 8 feet per minute, the loads intended for these different speeds being 150, 75, 37½ and 18¾ tons respectively. In addition to the main hoist, there is an auxiliary hoist, intended for the more rapid handling of lighter weights, the drum being mounted upon the same trolley, and, therefore, having the same traversing speeds as for the heavier loads. Two hoisting speeds are given this auxiliary drum; viz., 15 and 30 feet per minute, at which speeds it will lift 15 and 30 tons respectively. The trolley can be traversed on the bridge at two speeds, 25 and 50 feet per minute, while the bridge can also be given two speeds on the elevated track—30 and 60 feet per minute.

All the motions of the crane are controlled by seven upright levers shown standing vertically in the operating cage, each lever controlling two motions, which are plainly indicated to the operator by brass plates fixed upon the levers and the cage.

Square shafts are employed for driving throughout, the main shaft passing along above one of the supporting girders and between the truck wheels, similar shafts being used to drive the various motions of the trolley, and passing along at either side of the bridge. There is a friction clutch by which the main shaft is driven, and which can be controlled from the operating cage. Provision is made for preventing over-travel of any part of the crane, the motion being automatically thrown out of gear just before the limit of its movement is reached, the lever controlling the motion being returned to its neutral position. Automatic brakes are applied to the hoisting motion whenever the operating clutches are thrown out, thus preventing the load from running down.

Other smaller cranes were built by the same company, which are in use in the same building, one of these being shown in the first illustration, Fig. 1, which is a general elevation in transverse section (looking north) of the 12-inch gun shop. The smaller crane on the lower level is of 40 gross tons capacity, and is arranged to pass under the larger crane, which is the subject of the present article, and which is seen in position above, with lower chain sheave block at its highest point, and suspended there to a "Krupp" gun 42 feet long, 15¾ inch caliber, and weighing 119 tons. (This gun was selected only to give an idea of its proportion, and it is not certain that this type and design is the class selected by the government.)

Fig. 1.



THE LARGEST TRAVELING CRANE.

On the ground floor is shown a 14-inch gun-boring lathe. Sufficient dimensions are given upon this drawing to give one a very good idea of the general proportions of the building and cranes.

The truck which supports the crane bridge at the side of the building, where the main square driving shaft is located, is shown by Fig. 2 (page 2), which gives plan, side and end elevations. Upon this truck is placed the machinery for receiving and transmitting motions to the several transverse shafts parallel with the crane bridge, and which drive the trolley mechanism.

The several motions controlled by the machinery on truck are as follows: Two changes of speed for main hoist; two changes of speed for independent hoist; two changes of speed for transverse travel; two changes of speed for longitudinal travel; with powerful reversing clutches for reversing travel of crane on track backwards and forward. It will be observed that truck is composed of one longitudinal box-beam, built of 15-inch steel channels and I beams,

with top and bottom tie plates in one continuous length, riveted together, and planed smooth top and bottom for true surface in securing the several parts. It will also be observed that the ends of crane girders are located 12 feet from center to center, and directly beneath box-beam are two separate truck carriages, with four steel wheels each. Securely bolted to box-beam are four cast-iron bearings having a convex surface, with shoulders at each end for contact with same on each piece. These bearings are 39 inches long, 22 inches wide. The carriage frames are of cast-iron box section and concave bearings to suit; the male bearings are secured to box-beam. The object of this construction is to allow for compensation in transverse direction of building, in view of possible deflection of crane bridge under extreme conditions, or lateral deflection in longitudinal track, and prevents every possibility of bringing an undue load on inner track wheels, and to prevent undue strain by jamming or locking of teeth, or changing of centers in spur wheels transmitting motion to machinery above box-beam. The shafts above box-beam are central with ends of crane girders, and from center of these shafts the radii of curves in these compensating bearings are struck. These bearings are truly turned and scraped, with deep spiral grooves, and cored reservoirs in lower bearings for waste to saturate with oil for lubricating.

The large intermediate or "idler" spur wheels transmitting motion from square shaft to machinery above box-beam, and same on opposite end, driving bridge travel, are fulcrumed and secured as part of lower trucks, thereby allowing an independent motion of box-beam with machinery above, and each lower wheel truck, without binding of parts.

The steel track wheels on separate truck not driven, revolve loose on axles, having steel bushings hardened in oil, with hardened steel roller or pin bearings. The axles are stationary, and secured to truck frame. On driving end the steel track wheels are keyed to axles, and these revolve loose in frame, having steel bushings hardened in oil, with hardened steel roller or pin bearings. These steel track wheels have large bevel wheels securely keyed and bolted, and driven by steel bevel pinions, and are driven as shown, both sides of truck frame.

Crane bridge is composed of two box section, wrought-iron, curved girders. Total length, 63 feet 5 inches; depth at each end, 28 inches; depth in center, 60 inches; width of top and lower flange, 29 inches; web plates, 16 inches center to center. Top and bottom cover is composed of two wrought-iron plates, 29 inches wide, $\frac{9}{16}$ inch thick, total $1\frac{1}{8}$ inches. Web plates $\frac{9}{16}$ inch thick, secured by internal and external angles 6 inches by 6 inches by 1 inch thick. Cover plates and angles are in one piece, of continuous length. Web plates in four pieces, with ends and top planed to insure accurate butt joints, united by 15 inches by $\frac{3}{8}$-inch splice plates. Bottom end of web plates truly chipped even with angles to receive cover plates, which are secured by $\frac{3}{4}$-inch rivets. All other parts are secured by $\frac{7}{8}$-inch rivets. Cast-iron distance pieces are placed between webs, at intervals to suit shape, secured by one-inch through-bolts, with cast-iron washers on outside of webs. Quality of iron required in these crane girders was of the best, tough, fibrous, ductile, and uniform in quality. Required limit of elasticity not less than 26,000 pounds per square inch. (The attention of bidders was called to the fact that the elastic limit was one of the most important points in the quality of material). The test specimens, when taken from angle or other shaped iron, of less than $4\frac{1}{2}$ square inches sectional area, required to have an ultimate resistance of not less than 50,000 pounds per square inch, with an elongation of at least 15 per cent. in a length of 8 inches. A similar specimen, when taken from plate iron not over 24

Fig. 2.

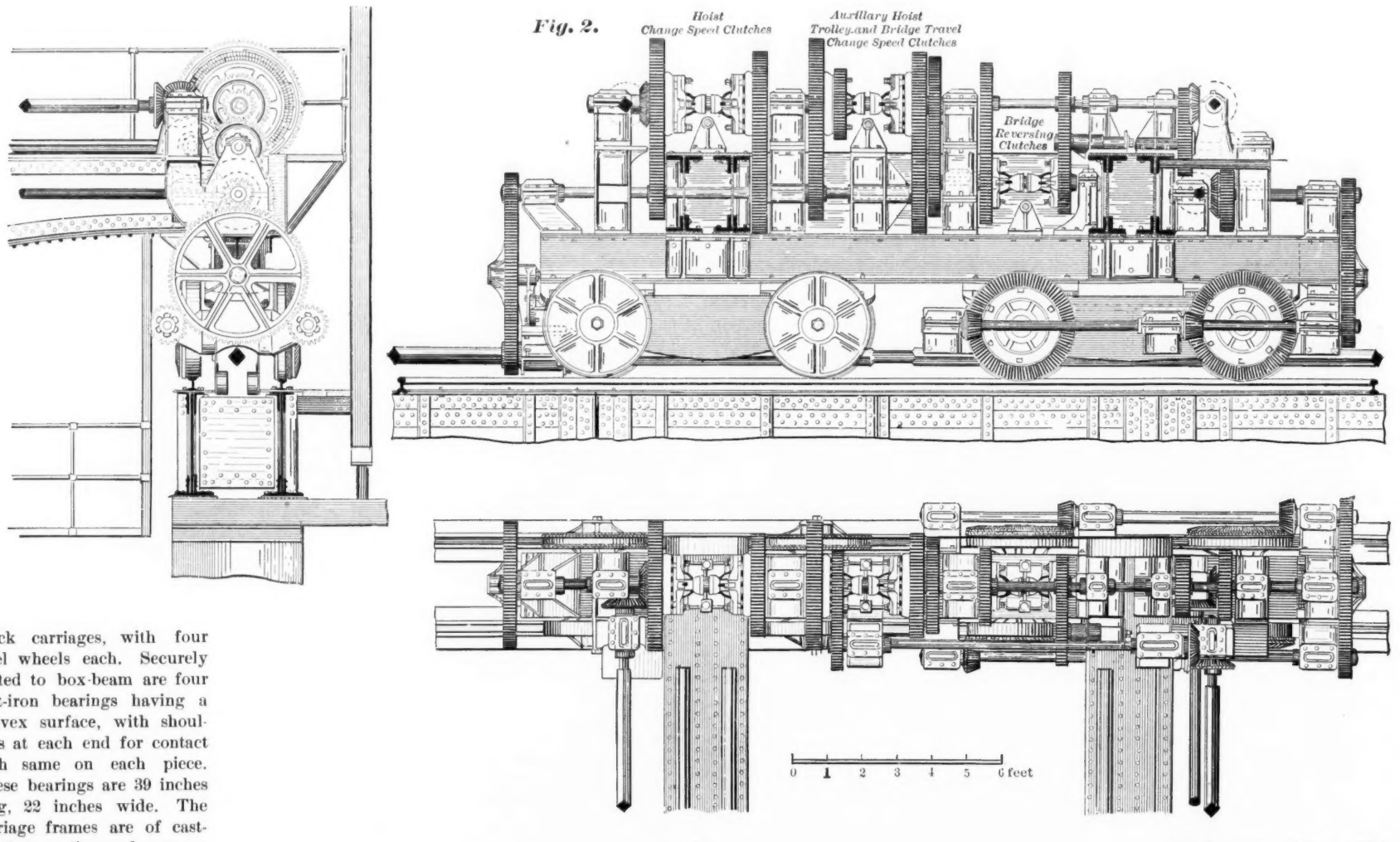
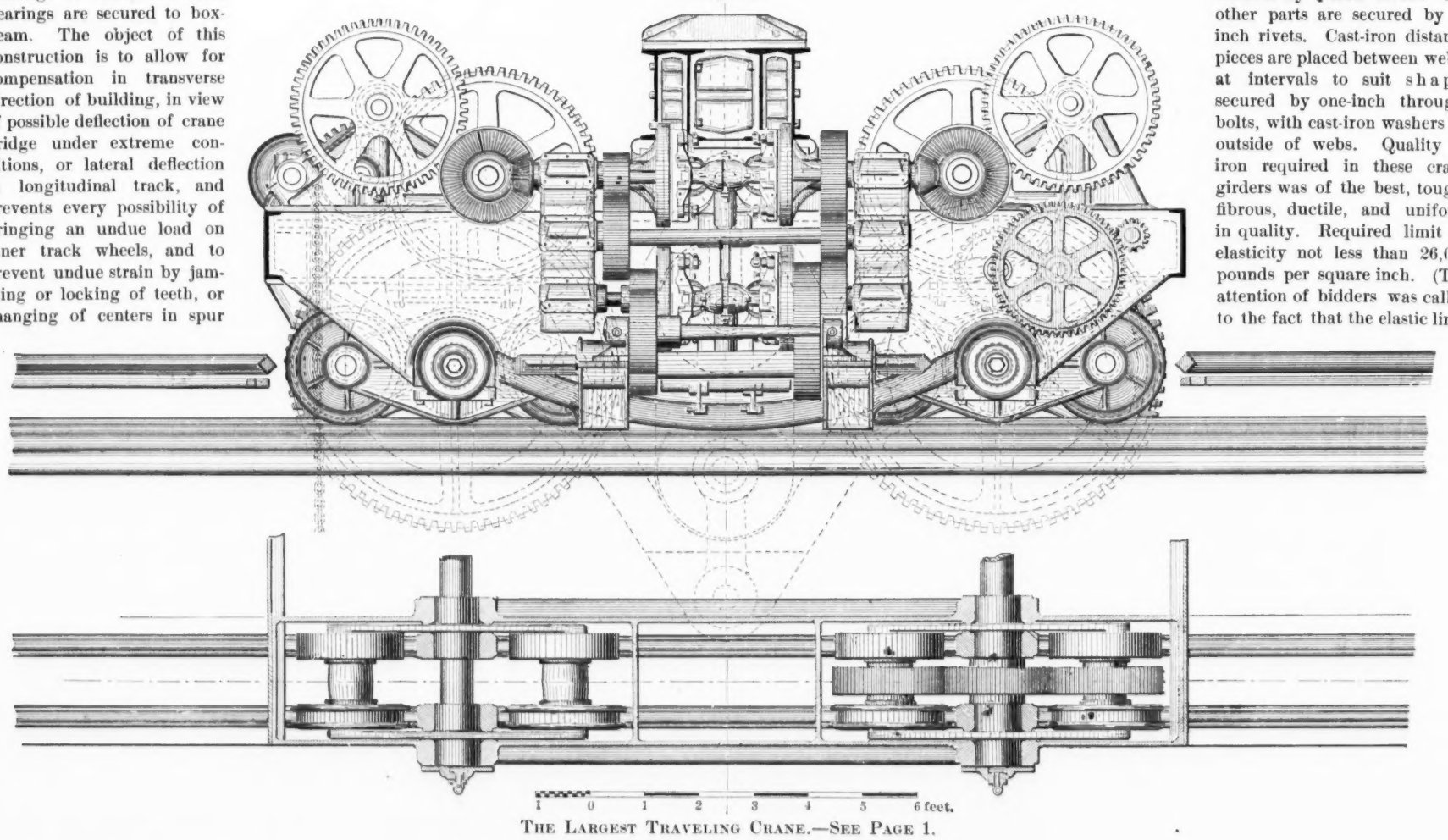


Fig. 3.



THE LARGEST TRAVELING CRANE.—SEE PAGE 1.

inches wide, required an ultimate strength of not less than 48,000 pounds per square inch, with an elongation of at least 15 per cent. in 8 inches. Reduction of area in every case required to be not less than 20 per cent. Each girder, without rails, brackets or machinery, weighed about 24 tons.

Fig. 3 represents a general side elevation of trolley, with machinery for reversing and changing speed of main hoist. It includes also a sectional plan through main axles and trolley frame, showing the manner of construction and location of equalizing beams securing track wheels.

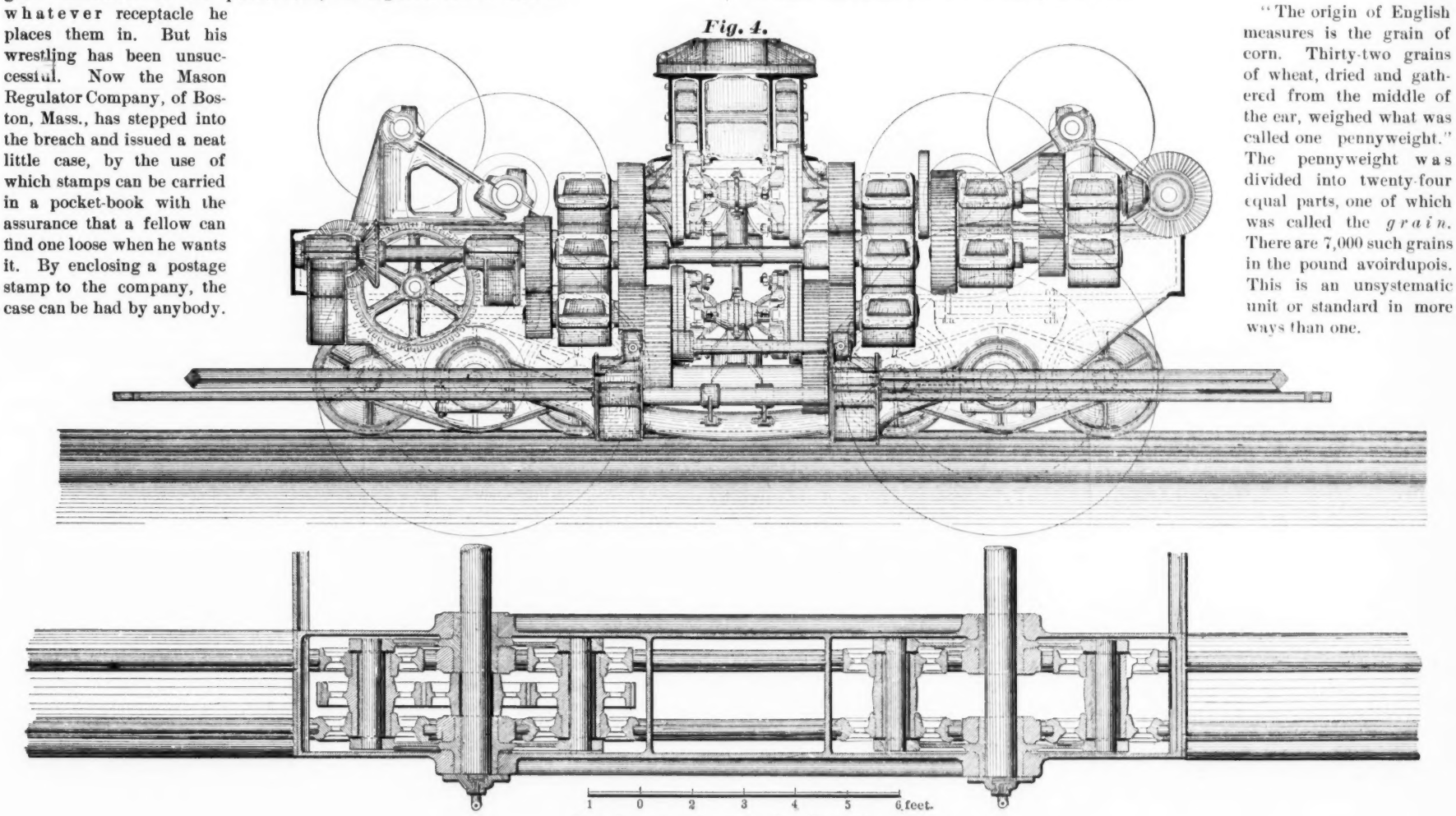
Fig. 4 is a drawing representing a general side elevation of trolley, with machinery for reversing both the travel of trolley to and fro on bridge, and the hoisting and lowering of independent or auxiliary hoist. Also shows a sectional plan through main axles, trolley frame and equalizing beams, with the manner of construction.

Other engravings and a further description of this crane will be published in a later issue.

Filling "A Long-felt Want."

The average man has wrestled with the problem of carrying postage stamps without having them, from innate perversity, glue themselves to his pocket-book, or whatever receptacle he places them in. But his wrestling has been unsuccessful. Now the Mason Regulator Company, of Boston, Mass., has stepped into the breach and issued a neat little case, by the use of which stamps can be carried in a pocket-book with the assurance that a fellow can find one loose when he wants it. By enclosing a postage stamp to the company, the case can be had by anybody.

Fig. 4.



THE LARGEST CRANE.—SEE PAGE 1.

Force, Motion and Work.

BY PEDRO.

TENTH PAPER.

MATTER—FORCE—NEWTON'S LAWS OF MOTION—SYSTEMATIC UNITS.

Thus far the reader has had nothing but a definition of dynamic force. He has not been informed why we should call this or that dynamic force, or why it should not be be called *der Constantinapolitanisherpfeifenmachersgeselle*, or why we should not multiply the weight of the body by the velocity of Jupiter, and divide by the distance of nowhere from anywhere, and call the result "dynamic force." Hence, if we should stop here, after giving simply a definition, the reader would not be any wiser than he is when told that "the mass multiplied by the velocity is the momentum of a body." Just as we were going to explain, however, *what* dynamic force is, we discovered that some of our work was slightly defective, as it would not bring us out at the objective point aimed at, but it was too late for corrections. We must therefore say that those who have taken exception to a part of our last two articles are correct to a certain extent.

To make corrections, and to present the subject in a better and a more elementary form, so that it may be better understood, we will commence again with force, and for the convenience of the reader we will repeat such parts as may be used to avoid referring to the eighth and ninth papers.

Thus far we have studied the laws of motion (first to eighth papers) without regard to the nature of the cause or agent which produces it. The study of force relates to that cause, and in studying the origin of motion we are at once called upon to consider matter in connection with force.

The amount of matter (or *mass*, as it is sometimes called,) that any body contains, is determined by its weight. For example, if a body weighs two pounds, we say that it contains two pounds of matter. If another body weighs ten pounds, it contains ten pounds of matter—five times as much as the first one, etc.

The foundation of dynamics, which is the science of force, matter and motion, was given to us by Isaac Newton in the following three laws of motion:

FIRST LAW OF MOTION. "*Every body continues in its state of rest or of uniform motion in a straight line, except in so far as it is compelled by force to change that state.*"

This first law simply means that matter is inert; that is, that matter of itself has no power of locomotion. When it is at rest it cannot move itself. When it has been set in motion by some agent it will continue to move forever if not stopped by some influence external to itself, because it cannot stop itself. When it has been set in motion by a force, it must continue to move with the same velocity that it had at the instant the force ceased to act, and it must also continue to move in the same direction that it was then moving, because it cannot do otherwise. This inert property of matter is called *inertia*.

SECOND LAW OF MOTION. "*Change of motion is proportional to force, and takes place in the straight line in which the force acts.*"

That is, when a body is acted upon by a force, the motion imparted to it by that force, if free to move, whether it was already in motion or at rest, is directly proportional to that force, and the motion imparted to it is in the direction in which the force acts, because, according to the first law, the body cannot do otherwise than move in obedience to the acting agent.

THIRD LAW OF MOTION. "*To every action there is always an equal and contrary reaction; or the mutual actions of any two bodies are always equal and in opposite directions.*"

This simply means that if we hold a stone upon our hand weighing two pounds, for example, the stone exerts a downward pressure upon our hand of two pounds, and, at the same time the hand exerts an upward pressure ("in the opposite direction") of two pounds upon (or under) the stone to support it.

If the opposite poles of two magnets are brought near to each other they will be drawn together, and the pressure or stress upon the first is exactly the same as that upon the second, but in the opposite direction.

Generally, when two bodies are pressed together, a stress is produced between them at their surfaces of contact, and the direction of the stress is at right angles to those surfaces at their point (or points) of contact, and from them towards each body respectively.

In these laws force and motion are spoken of as intimately connected in some way, and only one kind of force is mentioned. We will, however, divide the subject into *static force* and *dynamic force*, not because there is any physical difference between the two, but it is simply a convenient division of the subject, just as statics and dynamics are convenient divisions of mechanics. In the former case (static and dynamic force) the difference is simply one of time or quantity, as we shall see further on, while in the latter case (statics and dynamics) there is simply *no difference* or *some difference* of intensity.

STATIC FORCE.

Static force is simply that which can be expressed by weight, pressure, strain, stress, tension, compression, pull, push, resistance, attraction, repulsion, cohesion, adhesion, etc. It is any action or cause which can be measured by a spring balance, a weighing scale or a dynamometer. The unit of static force which we will adopt in these papers is the standard pound avoirdupois.

We get an idea of static force by lifting various objects of known weight. Static force is the cause of motion. For example, if we press against the edge of a book lying on the table, it will move if pressed sufficiently hard. It is pressure (static force) that causes the cannon ball to leave the muzzle of the cannon and fly through space. It is the pressure (static force) against the sails of a vessel that propels it. The steam pressure (static force) on the piston of the steam engine drives our locomotives, mills, etc.

SYSTEMATIC AND UNSYSTEMATIC UNITS.

The unit of static force in common use—the pound—is an unsystematic standard. Any standard measure is said to be systematic, first, when it is derived in a convenient way and directly from one or both of the two fundamental units of *length* and *time*. For example, the metric units of weight and measures are all systematic because they are derived directly from the unit of length—the meter. The standard pound in England and the United States "is a piece of platinum marked 'P. S. 1844, 1 lb.,' deposited in the office of the exchequer . . . " and is called "the imperial standard pound avoirdupois." This piece of platinum "is a thick disk about $1\frac{1}{6}$ inches across and 1 inch high, with a shallow groove around it near the top." Its volume is about $\frac{1}{1342}$ of a cubic foot.

"The origin of English measures is the grain of corn. Thirty-two grains of wheat, dried and gathered from the middle of the ear, weighed what was called one pennyweight." The pennyweight was divided into twenty-four equal parts, one of which was called the *grain*. There are 7,000 such grains in the pound avoirdupois. This is an unsystematic unit or standard in more ways than one.

Second, compound standard units of measure are systematic when each and every element by which it is measured is unity.

An element is any quantity which is reduced to its simplest form. For example, velocity and time are the elements of space or motion, which is a compound quantity because it is measured by the product of the first two — $s = v\,t$. The systematic unit of motion, therefore, is measured by the unit of velocity and the unit of time — *one foot of space* = velocity of *one foot* × time, *one minute*.

The cubic foot as a standard unit measure of volume is systematic, because it is measused by the *unit of length*, *unit of width* and *unit of thickness*. The imperial gallon, as a measure of capacity, is unsystematic, since it contains the awkward number of 277.274 cubic inches; also the United States standard gallon, which contains 231 cubic inches.

The Pennsylvania Railroad Company has a lawsuit on its hands, for refusing to carry coal for a private concern except at exorbitant rates. It ought to lose the suit.

LETTERS FROM PRACTICAL MEN.

A Hammer Blow.

Editor American Machinist:

There is probably no subject which is more frequently misunderstood or so incorrectly referred to as that of hammer blows.

The question is often asked, What blow will that hammer strike, or, what is the force of the blow delivered by a certain hammer, and the answer must be stated directly in pounds or tons, to give popular satisfaction. But it is just as absurd to speak of a blow of so many pounds or tons as it would be to speak of a yard of milk or a quart of steel rails, because weight is no measure of work, and the blow struck by a hammer can only be measured by the work it can do. In English-speaking countries the recognized measure of work is the foot-pound, and the blow of a hammer should always be stated in foot-pounds, to have any meaning at all; but how seldom is it done, and with what suspicion of ignorance would a hammer builder be regarded who should try to evade or qualify his answer as to the force of the blow delivered by his hammer, saying: "Well, that depends upon the material struck," or, "It cannot be stated definitely, but we take steam on top, and our hammer will do a great deal of hard work." The prospective purchaser, if not well versed in the principles of mechanics, might say: "That is all very well, Mr. Hammerbuilder, but I see by the AMERICAN MACHINIST of May 29th that a two hundred pound hammer can be built to strike an eight hundred pound blow, and I guess if you could do as well as that you would say so." But to the readers of the AMERICAN MACHINIST, who are somewhat familiar with the proper use of mechanical terms, the meaning intended to be conveyed by such a statement is rather obscure to say the least. In fact, it is very much like Keely's discoveries and revelations—they sound well to the public in general, but mean absolutely nothing to the scientific world.

The peculiar statement referred to is probably not so unusual as to attract much attention, but I think it would be of interest to know how those who speak of a hammer blow in pounds understand the measure to apply.

WILFRED LEWIS.

Philadelphia, Pa.

Making Rolls.

Editor American Machinist:

Replying to Mr. Stuart, in issue of 29th, respecting the "Making Rolls," would state that his whirling gate is a good feature, but, as we have been using that all the time, we cannot say that that relieved us, although we know that it helps us some. The party who offered us information on this question in previous issue did not seem to understand our trouble. If the "turning" in the lathe would give us good or bad rolls, I do not think we would have any trouble. Thanking both gentlemen for interest shown, and soliciting further help.

C. W. BENDER.

Device for Increasing Draught.

Editor American Machinist:

It is quite apparent to all that have anything to do with locomotives that there is no draught to get up steam until sufficient steam is raised to start the blower, and if any one is late there is no way to hurry matters.

As we have a small locomotive in our yard for shifting cars, and as we want this work all done before time to go to work, and having been annoyed a few times by there not being steam, the writer hit upon the following plan to avoid further trouble:

An enlargement of the smoke pipe that goes through the roof was made in the form of a telescope, the bottom of which could be let down onto the stack of the engine. This one lets down onto the flange where the netting is inserted. It would be as well not to make it so large, and only cover the bead on the top of the stack.

Now there is a fair draught, and steam is raised quickly, and, further, there is no smoking up the house, as it is all taken out through the smoke pipe.

This smoke pipe is supported by the roof as usual, and the sliding part is suspended by three cords, which are attached to the bottom at equal distance apart.

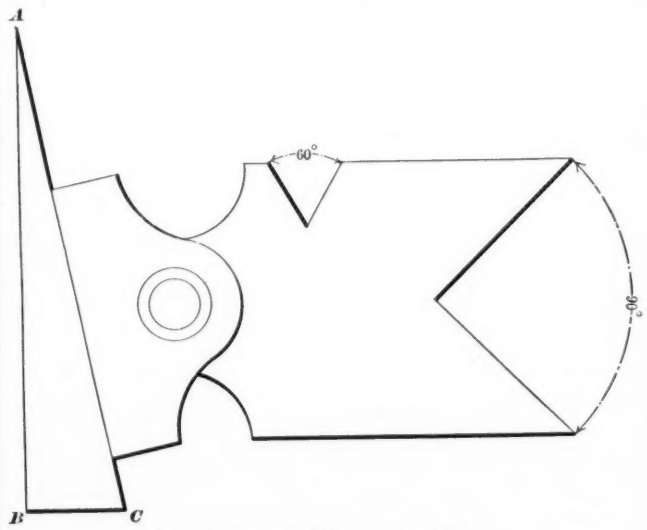
W. E. CRANE.

Clearance on Threading Tools.

Editor American Machinist:

In your Question and Answer column "W. E. P." asks for a rule for grinding the proper clearance of tools for cutting square threads and worms, and, knowing by experience what a time it is to get a tool right, I enclose rule and sketch for the benefit of those who don't know, and who may appreciate it. Draw the perpendicular A B equal to the circumference of the screw to be cut, then draw B C at right angles to A B equal to the pitch required; join A C and you have the angle of screw. The triangle A B C is drawn one-fourth full size for screw 3½" diameter, and two (2) inch pitch.

The gauge is made full size, and can easily be made of sheet-steel or brass. To use it set the bevel D to the line A C; place the tool on any flat surface, and, after applying the gauge to one side of the tool, reverse the gauge and apply it to the other side, when it will be seen if the tool has the proper angle, and also if the clearance be the same on both sides; the clearance should not be less than three degrees.



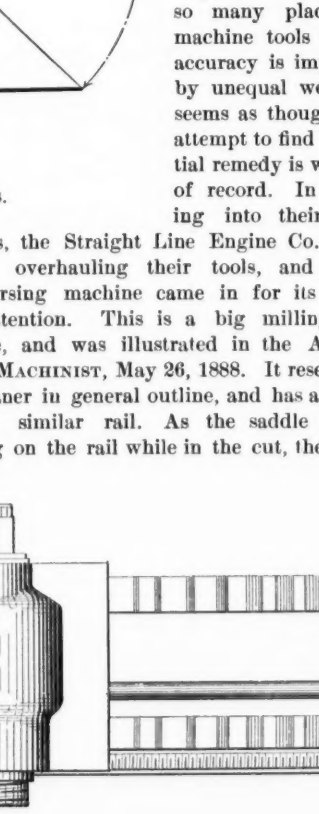
CLEARANCE ON THREADING TOOLS.

The large right angle shown in the gauge is 90°, and will be found useful when grinding the tool.

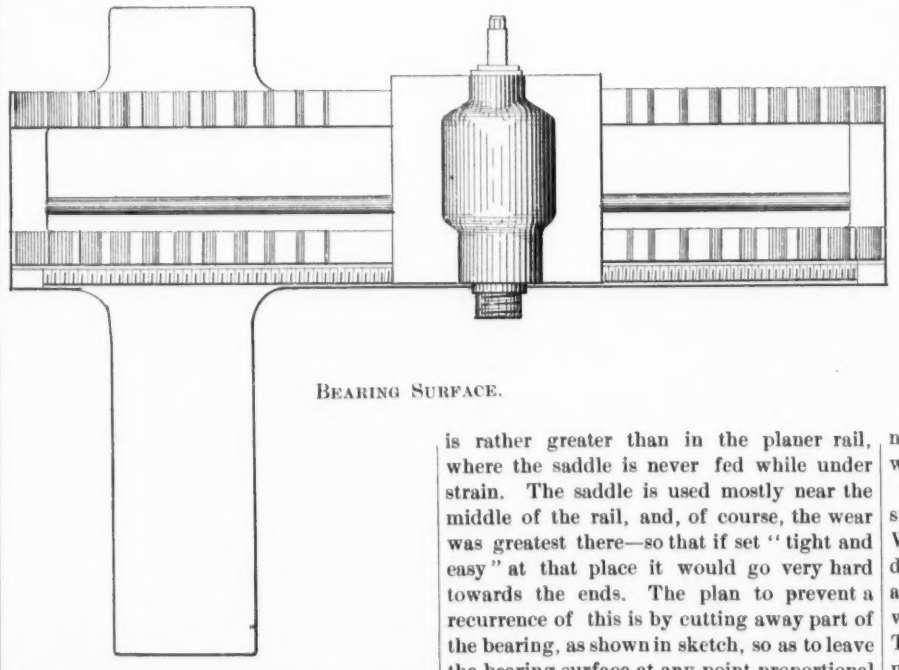
Screw tools made of round steel can easily be set to angle of screw, and answer purpose as well as square.

E. A. ROTH.

Pittsburgh.



INCREASING DRAUGHT.



BEARING SURFACE.

Bearing Surface in Proportion to Wear.

Editor American Machinist:

Every little while a new idea comes up in mechanics, which, while apparently all right, requires so much courage to carry out, that it is easier to go on in the regulation way, and wait for some one else to do the experimenting. About thirteen years ago Professor Sweet suggested the idea of equalizing the wear on a lathe lead screw—intended for fine work—by cutting away part of the thread where it was used but little, and so leaving the wearing surface at any point approximately proportional to the amount of wear. Although the idea seems a good one, probably no one ever tried it. A screw wouldn't look pretty that way, and it is so much easier to do as everybody else does—and let the wear all come in one place.

Professor Sweet has just been trying the scheme in another way, and as there are so many places in machine tools where accuracy is impaired by unequal wear, it seems as though this attempt to find a partial remedy is worthy of record. In moving into their new shops, the Straight Line Engine Co. have been overhauling their tools, and their traversing machine came in for its share of attention. This is a big milling machine, and was illustrated in the AMERICAN MACHINIST, May 26, 1888. It resembles a planer in general outline, and has a somewhat similar rail. As the saddle is fed along on the rail while in the cut, the wear is rather greater than in the planer rail, where the saddle is never fed while under strain. The saddle is used mostly near the middle of the rail, and, of course, the wear was greatest there—so that if set "tight and easy" at that place it would go very hard towards the ends. The plan to prevent a recurrence of this is by cutting away part of the bearing, as shown in sketch, so as to leave the bearing surface at any point proportional to the wear. The spots cut away are only deep enough to insure clearance after some wear—about $\frac{1}{64}$" deep. How the scheme works remains to be seen. We shall watch for general results with a good deal of interest.

E. J. ARMSTRONG.

Mechanics of the Chinese.

It is a remarkable fact that the dwellers in the celestial empire, notwithstanding their technical skill and their many important inventions, stand on a very low plane in respect to the natural sciences and their practical application. A recent occurrence illustrates the backward state of science in China. A firm of German electricians, by order of the young emperor, fitted the palace with electric lights. The first trial of the new illumination threw the imperial cabinet into a state of consternation, because such results could only be obtained, according to their view, by the aid of supernatural powers—very likely those of evil spirits. It was consequenly decided to remove at once the electrical lamps and machines from the palace. In their astronomical conceptions the Chinese stand yet bet in the age of Copernicus, believing that the sun revolves around the earth, of whose form and the way in which it is supported in space they entertain the strangest ideas. Of course, in such a country, astrology, soothsaying, and all the rankest superstitions still flourish, and a check can only be expected from the gradual influence of the many intelligent young men who have studied in European universities.

In the ordinary application of practical mechanics curious things are related of the pig-tailed nation, showing that Chinese education is based on ancient traditions, adhered to with great pertinacity. They display a knowledge of the principles of the lever and the pulley, but in the use of these appliances, known in early antiquity, they remain at the point that Europe passed thousands of years ago. In lifting heavy blocks of marble by means of a scaffold, they tie a rope around a stone, carry it over a beam, and with a bight around another beam below, while a lever is suspended from a higher beam, its short arm connected by a rope with the rope holding the stone. After one set of men have drawn down the lever, those holding the main rope pull it tight, and a workman above slips down the knot of the lever rope for another hoist.—*The News Universum.*

Measuring Clearances in Engines.

BY DR. R. H. THURSTON.

The measurement of the volumes of the clearance and "dead spaces" of engines is often a matter of importance, and is always one of some difficulty, if exactness is sought. In the course of work in the regular operation of the mechanical laboratories of Sibley College this problem must often be solved, and a number of ingenious devices have been resorted to by Mr. Bissell, the instructor in charge of work. In one case it was found that there was sufficient leakage, when the engine was cold, to permit some uncertainty to arise as to the exactness of the measurements effected when water was used to fill the spaces to be determined, though it was not enough, when hot, to affect appreciably the measurements made during the period of operation. A very heavy cylinder oil was substituted for the water, and it was found that it answered the purpose admirably, none of it being lost; and successive measurements at various intervals and various times taken for the work, gave identical results; that is to say, the oil would not penetrate in sensible quantities where water would be lost.

Perhaps the best method yet tried was that suggested recently, during the work of Mr. Wiechardt, of the University of Iowa, while doing graduate work in the laboratories, and as later tried by Mr. Bissell. In place of water or oil, fine bird shot was employed. The result was absolutely satisfactory. The measurements were exact, and not a shot could be lost, the density of the lead making it certain that none could be left in the engine undetected by the weighing. In all work thus done every pellet was recovered.

A cubic foot of aluminum weighs 162 lbs.

Foot-power Mitering Machine.

This machine is designed for mitering moulding accurately and quickly, and is made in two sizes, the No. 3 for moulding three inches wide, the No. 5 five inches wide. The miter gauge which is shown on the machine moves to and from the knife by a link motion, operated from the shaft and lever shown below the bed.

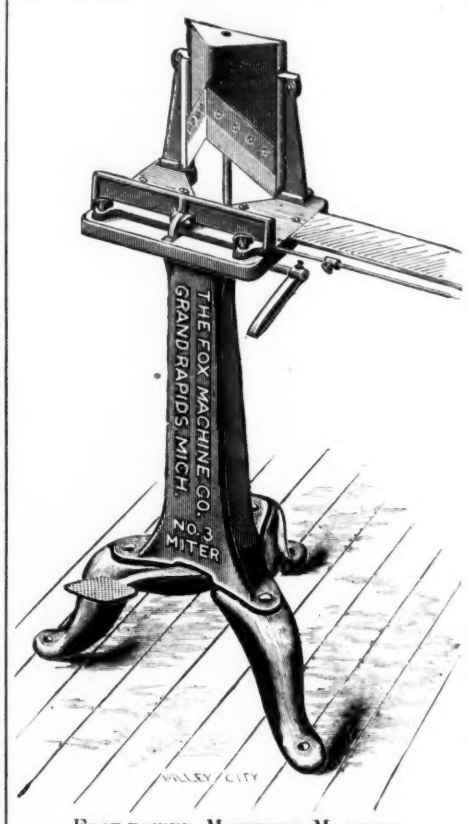
The sliding gauge has a pawl which drops into the notches on the bed, which prevents it from being forced back, and locks it into position.

The gauge also carries a rod which has a stop, to cut moulding of uniform length. This, as will be observed, is adjustable. The rule is graduated to suitable lengths. The bed plates, which are shown next to the knives, are made adjustable, so that they can be elevated next to the knife to give the moulding a slight under-cut. This is a very valuable feature in cutting hard wood moulding, or cutting mouldings which are warped, as it always insures a tight joint on top. The carriage is provided with an adjustable stop so that it can be limited at any point in its upward movement, which is a valuable improvement, as in cutting narrow moulding it is not necessary to raise the foot the full height of the stroke. The carriage is secured to the frame in the same manner as the hand power machine, which has previously been illustrated in our columns, and, being made in the form of a triangle, combines great strength with the least amount of metal.

It will be understood that this machine cuts two miters at each stroke, or, in other words, makes the joint ready to be put together.

Stops and gauges are also supplied by which the machine may readily be used for trimming square or at any desired bevel.

The makers are the Fox Machine Co., Grand Rapids, Mich.



FOOT-POWER MITERING MACHINE.

Where to Serve an Apprenticeship.

BY W. H. BOOTH.

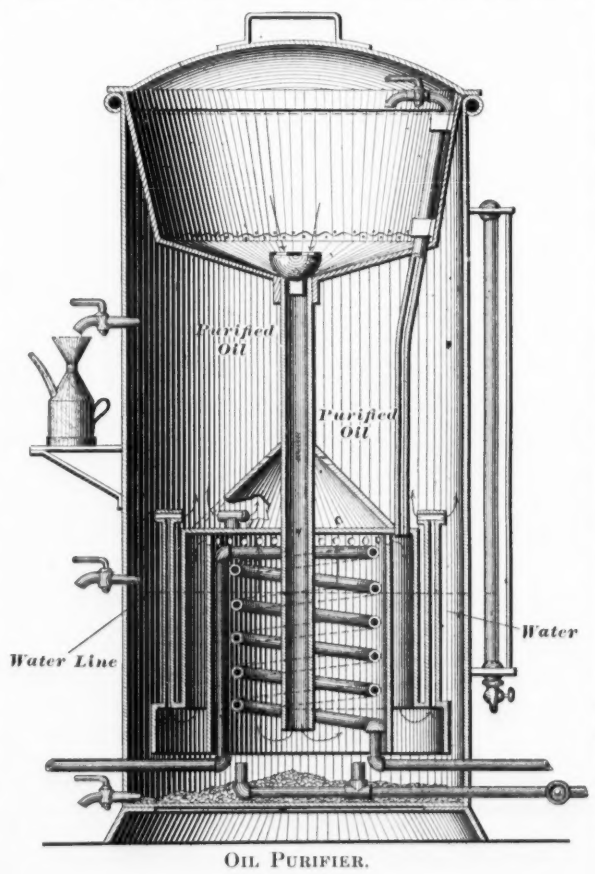
I am not prepared to state that the boy who is apprenticed in a high-class shop will not turn out so good a workman as he who has come through some little shop in a country town, but my experience strongly points in that direction. So long as in the small shop reasonably good work is expected, the small shop will turn out better men than the large. In a large, well-furnished shop there is some first-rate contrivance to facilitate every bit of work, and a man brought up to their use is frequently much at a loss if fortune afterwards puts him into a smaller establishment; but when a youth starts in at a small place he learns infinitely more than he otherwise would do. He has to contrive methods of fixing work, and he has to grind his own tools, and so learns very much indeed that he may entirely lose in a place where there is a tool-room, unless he be fortunate enough to take a turn in the tool-room, which does not fall to the lot of less favored apprentices.

In the small shop the apprentice gets infinitely better opportunities of seeing and doing every variety of work, than in a large place making one steady thing. We have observed that the tendency of a training in a large shop doing one special class of work is to produce men who either fall entirely out of the engineering profession, or become settled down in a fairly remunerative billet, from which they steadily progress to better, and need rarely be out of occupation. In a small shop the apprentice is either quickly driven away by discomforts and hard work, or he becomes successful on exactly opposite lines to those of the specialist. He has probably more hard knocks in life, and has many changes to make, but is found able to cope with all the different classes of work he does meet, and the possibility is that he attains finally a better position than his specialist fellow, and even takes, in the long run, the highest-paid specialist appointments over the heads of the specialists themselves.

To the youth who has the luck to get into a first-class works—and boys are apt to consider it luck—we would say, take care that you do not become too much like the special tools which you see around you. Do not become stereotyped, and do not fancy, when you find yourself with every detail of the machine you assist to make, that you are now an engineer. If you are in a locomotive shop, you will probably become so familiar with every detail and general dimension that you would be able to instruct draftsmen to prepare drawings of a locomotive to your "own design," which would be an embodiment of the general type of that class as made by the works where you were apprenticed, modified only by any imperfections of memory, and the individualism of the man who put your orders into form as a drawing. When built to "your design" it is probable that your engine may work well, and even develop such good qualities as to obtain for you the credit of having of your own genius produced a first class machine. As a fact, you have really produced a good average copy of the regular practice of another shop, and you may have no knowledge whatever of the principles underlying the dimensions you have made choice of. You are not an engineer, but a copyist, perhaps unconsciously so, but a copyist all the same, and those who know you will recognize the resemblance in your productions, and in the productions of others who had the same teaching as you, to the ideas of the same original master mind. Now, there is no harm in such similarity of productions, if only you adhere to the original; for the reason that, after careful consideration, you can see good reason for doing so. Why do you use a 52-inch boiler, or 66 inch wheels, or why do you single-rivet some seams and double-rivet others? and so on. If you do these things because for your haulage you found 72-inch wheels did not allow you to use enough steam on each 100 yards of line passed over, because you know a boiler is weakest against circumferential stress, then you do well; but if you do them because these are the figures on a blue print, which no one but yourself gets to see, then you are not worthy of your position. We have known men brought up in large works, whose knowledge did not even extend to the calculation of the strength of a boiler barrel. These men could draw well, arrange the parts of an engine, and get out good details, but they had never had occasion to calculate anything, merely receiving in faith all dimensions from a chief. Such men could not comprehend the stresses produced amongst a system of brake levers with floating fulcrums, and yet they got along, and did well in this life, simply because they could do some things well, and copied precedents slavishly when out of depth. The small-shop man on the other hand, is very apt to undervalue the aids which big shop facilities afford of doing accurate mechanical work. From a commercial point of view accuracy is essential, for without it there can be no interchangeableness of parts; and though we would never sympathize with the repinings of one whose lot was first cast in a small shop, we would certainly advise him, when he had obtained that handiness which comes from such teaching, to take a turn in a big works, where he would obtain a finish, and become a better man in every respect, whilst not losing in any way that versatility which comes from a training in a general shop. Education in a technical college will never satisfactorily supersede actual work in a shop, and it is doubtful if the familiarity acquired with tools in such a place is much more than a few weeks of actual workshop practice will give. The training of the technical school is to our mind chiefly valuable as showing a youth that certain principles underly all correct practice, and he is led to think, in place of blindly accepting data and precedent as uncontrovertible axioms.

A New Oil Purifier.

The illustration represents a new oil purifier of comparatively simple construction; its action is based upon the relative difference in the specific weight of oil and water, and does not require any chemicals, cloths, charcoal or other filtering substances, except water. The apparatus consists of a cylindrical vessel, with an oil reservoir on top and filtering chambers below. The lower part of the apparatus contains a limited amount of water; a coil of pipes, through which steam flows, is placed in the inner filtering chamber; a glass gauge to indicate the water level and purified oil level, faucets for drawing off the oil or water, and a blow pipe completes the apparatus.



OIL PURIFIER.

The oil which is to be purified is poured into the reservoir; it then runs through the center tube, and is discharged at the bottom of the inner filtering chamber. The weight due to the high column of oil forces the oil to pass through the water, and the heat from the coil of pipes will cause it to become somewhat diluted, and drop its impurities to the bottom of the cylindrical vessel. The oil collects and fills the space above the water level in the inner filtering chamber, and from there flows through small apertures into an annular space, where the oil is again forced through the water, but this time downwards; from thence it is forced through the column of water in the vertical tubes and discharged in a purified state into the cylindrical chamber above the water level. The blow-pipe extending from the filtering chamber to the top of reservoir, answers as an outlet for any gases that may form; it will also prevent overflowing by discharging any rising or overheated oil back into the reservoir. The steam pipe serves to thoroughly blow out and clean the whole apparatus from time to time.

It is claimed that, no matter how dirty or gummed up the oil which has been previously used may be, it will come out of the purifier in a better condition than when it left the oil merchant.

The apparatus is not liable to get out of order, nor choked or stopped up, as it works and cleans itself automatically.

Whenever the water or dirt gets too high, the spigot must be opened. If the water gets too low, or if it is desirable to use all the oil, more water must be thrown in.

The patentees and general agents are Bruno Grosche, 36 Vesey street, New York City, and J. Bigler, Newburgh, N. Y.

Propulsion by electricity is effectually demonstrated at the Edinburgh Exhibition. The site favored this, as it is skirted by the Union Canal, and four launches are running on the canal. These were designed by Messrs. Morton & Williamson, Glasgow, and built by Messrs. T. B. Seath & Co., Rutherglen. The dimensions are, 40 ft. long, 6 ft. 6 in. beam, and the draught of water is 2 ft. 1 in. They each carry forty passengers. The electrical equipment has been supplied by Messrs. M. Immisch & Co., London, and is similar to that used on the Thames launches. The charging plant consists of a 25 horse-power engine and an Immisch dynamo, and the switch arrangement is suitable for charging all the four launches at the same time. The re-charging is done during the night and the launch can run ten to twelve hours. The motors are capable of an output of about 3½ brake horse-power, working up to 800 revolutions per minute, and the speed with the maximum load on board is six miles an hour. The propellers are coupled direct to the motor shafts. A ball-bearing thrust block is attached to the motor's bed and is constructed in combination with the plain bearing of the motor. This is the invention of the Messrs. Immisch, and has been patented by them. The steering, starting, and reversing gear is so arranged that one man has the launch entirely under control. These, so far as we can learn, are the first electric launches which have been worked commercially in Scotland. —*Engineering.*

The Mail and Express has the following:

The dispatch which we publish to-day from the *Mail and Express* canoeist tells of a daring achievement. Notwithstanding the fact that more than eighty lives had been lost at the falls of the Ohio, at Louisville, in the past ten years, the plucky canoeist rode down them in his little paper canoe "through the foam and over the waters like an arrow," coming out safely on the lower side.

It was a bold feat, skilfully performed, and the canoeist is to be congratulated on his performance of it.

People will differ in regard to such feats of foolishness. In our opinion, those who perform them for the sake of a little cheap notoriety would do the world better service in a lunatic asylum.

Odontics, or the Theory and Practice of the Teeth of Gears.

BY GEO. B GRANT.

SIXTH PAPER.

76.—THE CYCLOIDAL SYSTEM.

If the curve known as the cycloid is chosen as the determining rack odontoid, (31), the resulting tooth system will be cycloidal.

It is commonly called the "epicycloidal" system, because the faces of its teeth are epicycloids, but, as the flanks are hypocycloids, it seems as if the name "epihypocycloidal" would be more clumsy and accurate.

There is no more need of two different kinds of tooth curves for gears of the same pitch than there is need of two different kinds of threads for standard screws, or of two different kinds of coins of the same value, and the cycloidal tooth would never be missed if it was dropped altogether. But it was first in the field, is simple in theory, is easily drawn, has the recommendation of many well-meaning teachers, and holds its position by means of "human inertia," or the natural reluctance of the average human mind to adopt a change, particularly a change for the better.

77.—THE CYCLOIDAL TOOTH.

The cycloid is the curve A that is traced by the point p in the circle C that is rolled on the straight pitch line $p\ l$, Fig. 54. The normal at the point p is the line $p\ q$ to the point of tangency of the rolling circle and the pitch line.

The line of action is the circle $l\ a$ of the same size as the roller C.

As no tangent arc can be drawn to the line of action from the pitch point O as a center, no terminal point (18) exists. As there is no point upon the line of centers from which a circle can be drawn tangent to the line of action, there will be no cusps, (16) except on the pitch line.

The cycloidal tooth can be drawn by the general method of (24), but there are several easier methods which will be described. There are numerous empirical rules and short cuts to save labor and spoil the tooth, which will not be described.

When the pitch line is of twice the diameter of the line of action, the flank of the tooth is a straight line. If the pitch line is less than twice as large as the line of action, the flank of the tooth will be under-curved, as shown by Fig. 55, and it is customary to avoid the resulting weak tooth by limiting the line of action to a diameter not greater than half that of the smallest gear to be used.

78.—SECONDARY ACTION.

The secondary line of action (21) is a circle, Fig. 56, differing from the pitch circle by the diameter of the primary line of action, either inside or outside of it.

When the internal secondary line of action of the internal pitch line coincides with the external secondary line of action of the pinion there will be secondary contact between the gears, the face of the gear working with the face of the pinion at a point of contact upon the combined secondaries. Fig. 57 shows this for the cycloidal tooth, the two faces working together at the point a. As both secondaries are circles they must coincide, and the secondary action will be continuous.

When the teeth are also in contact at b on the primary line of action, there will be a double contact.

79.—INTERNAL INTERFERENCE.

If the secondary lines of action do not come together the teeth will not touch each other at all, but if that of the gear is smaller than that of the pinion the teeth will cross each other and interfere. The line C, Fig. 57, is the face of the gear tooth, and the line d is the face of the pinion tooth having a primary line of action equal to the difference between the pitch lines. The secondary line of each gear coincides with the pitch line of the other, and the faces interfere with each other the amount shown by the shaded space.

The only remedy for internal interference is to reduce the diameter of the primary line of action to half the difference between those of the pitch lines, or else to leave off one of the faces of the teeth.

The discovery of the law of internal cycloidal interference is due to A. K. Mansfield, who published it in the "Journal of the Franklin Institute" for January, 1877. It was afterwards re-discovered by Professor MacCord, and more thoroughly applied and illustrated in his "Kinematics."

When interference is avoided by omitting one of the faces of the teeth the primary line of action may be enlarged, but it must not then be larger than the difference between the pitch diameters.

Fig. 58 shows on the right the action when the face of the gear is omitted, and on the left the action when the face of the pinion is left off. The teeth will just clear each other, each one touching the other at a single point a in its pitch line.

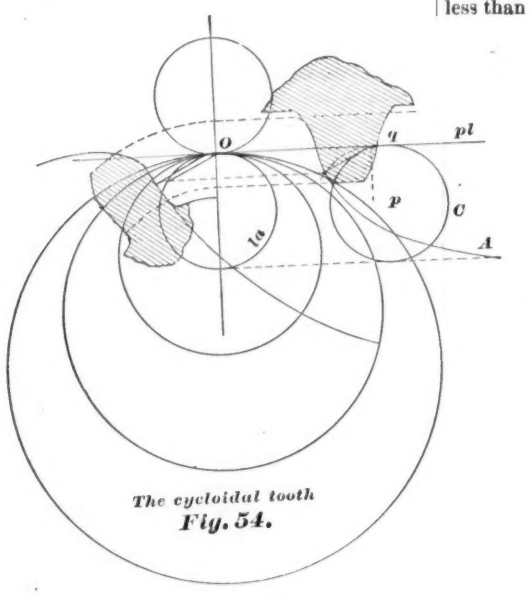
As the contact at a is not a point of practical action, care must be taken that the arc of action at the primary line of action is as great as the circular pitch, for otherwise, as in the figure, the gears will not be in continuous primary action.

80.—THE STANDARD TOOTH.

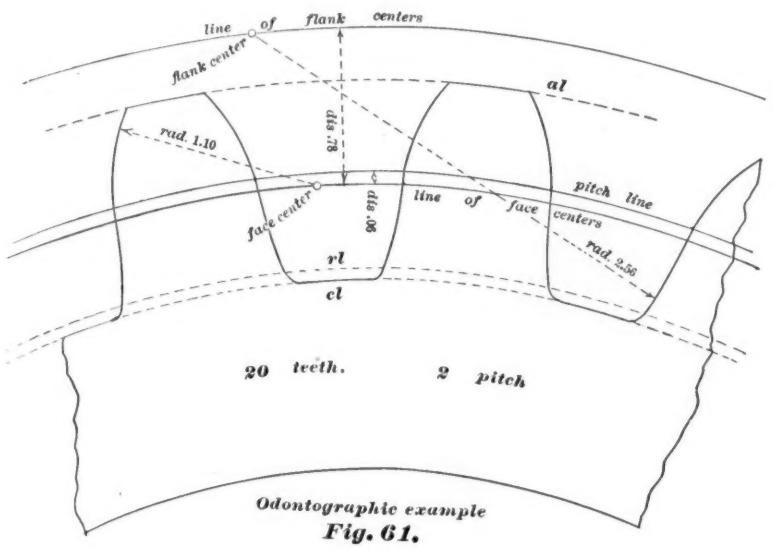
The standard tooth (42), selected for the cycloidal system, is by common consent the one having a line of action of half the diameter of a gear of twelve teeth, so that that gear has radial flanks.

The rule for internal interference, simply stated, is that the diameters of the pitch lines must differ by the sum of the diameters of the lines of action if the teeth have both faces and flanks, and by the diameter of the acting line of action if the face of either gear is omitted. For the standard interchangeable system, the gears must differ by twelve teeth if both teeth have faces, and by six teeth if one face is omitted.

Fig. 62 shows the secondary contact in the case of a standard gear of twenty-four teeth working with a pinion of twelve teeth, and it is to be noticed that the teeth nearly coincide between the two points of contact. Where there is secondary contact the teeth practically bear over a considerable surface instead of at a line.



The cycloidal tooth
Fig. 54.



Odontographic example
Fig. 61.

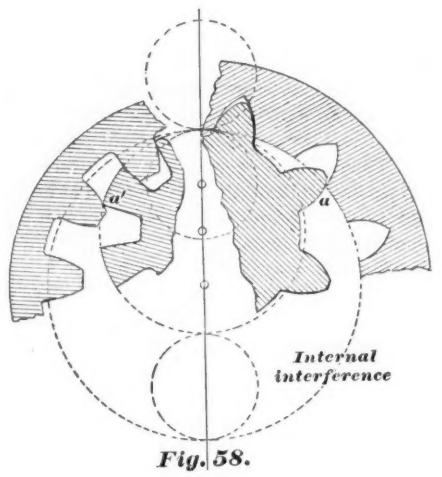
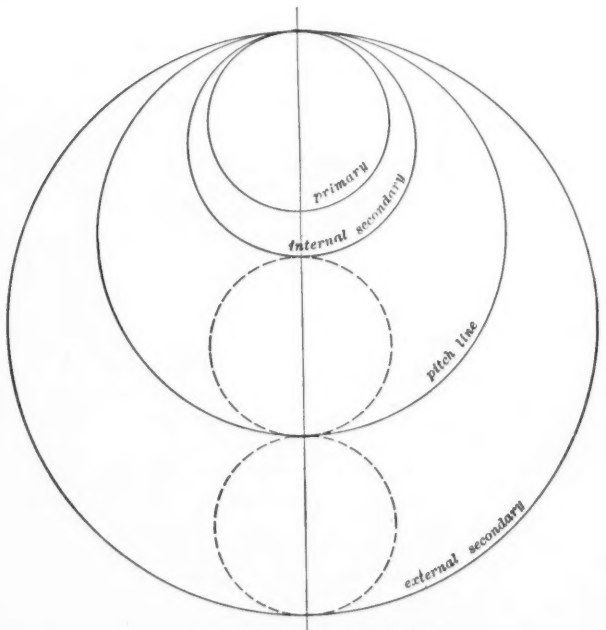
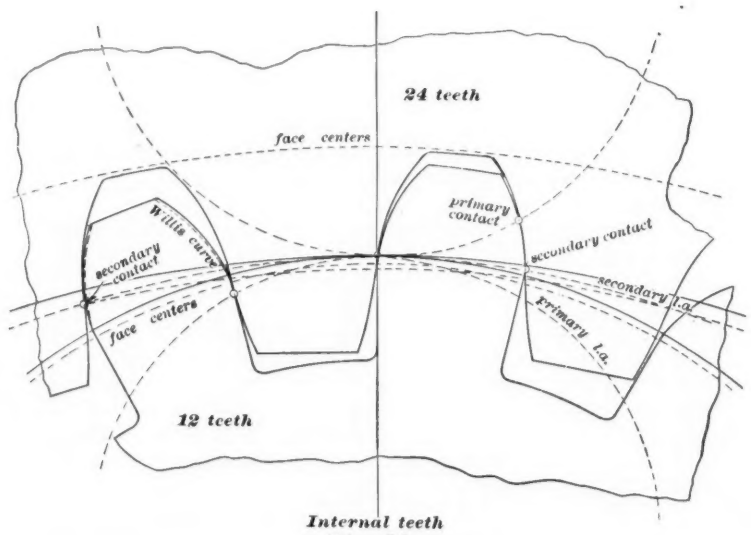


Fig. 58.



Secondary lines of action
Fig. 56.



Internal teeth
Fig. 62.

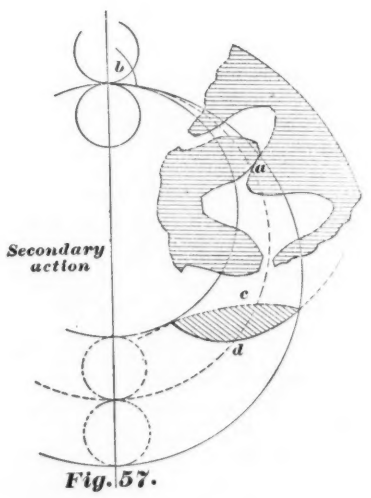


Fig. 57.

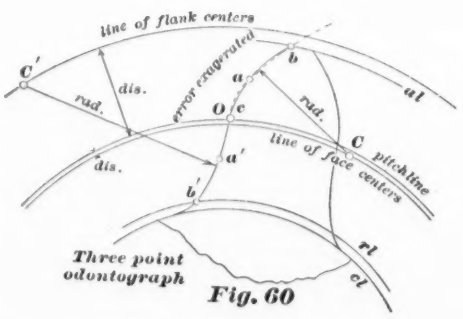
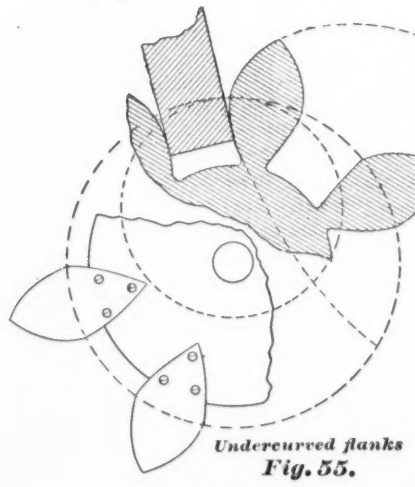
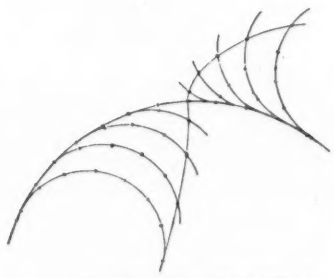


Fig. 60



Undercurved flanks
Fig. 55.


Construction by rolling
Fig. 59.

The standard adopted by manufacturers of cycloidal gear cutters is that having radial flanks on the gear of fifteen teeth, but it is not and should not be in use for other purposes. If any change is made, it should be made in the other direction, to make the set take in gears of ten teeth.

It must be borne in mind that the standard adopted does not limit the set to the stated minimum number of teeth, but that it simply requires that smaller gears shall have weak under-curved teeth.

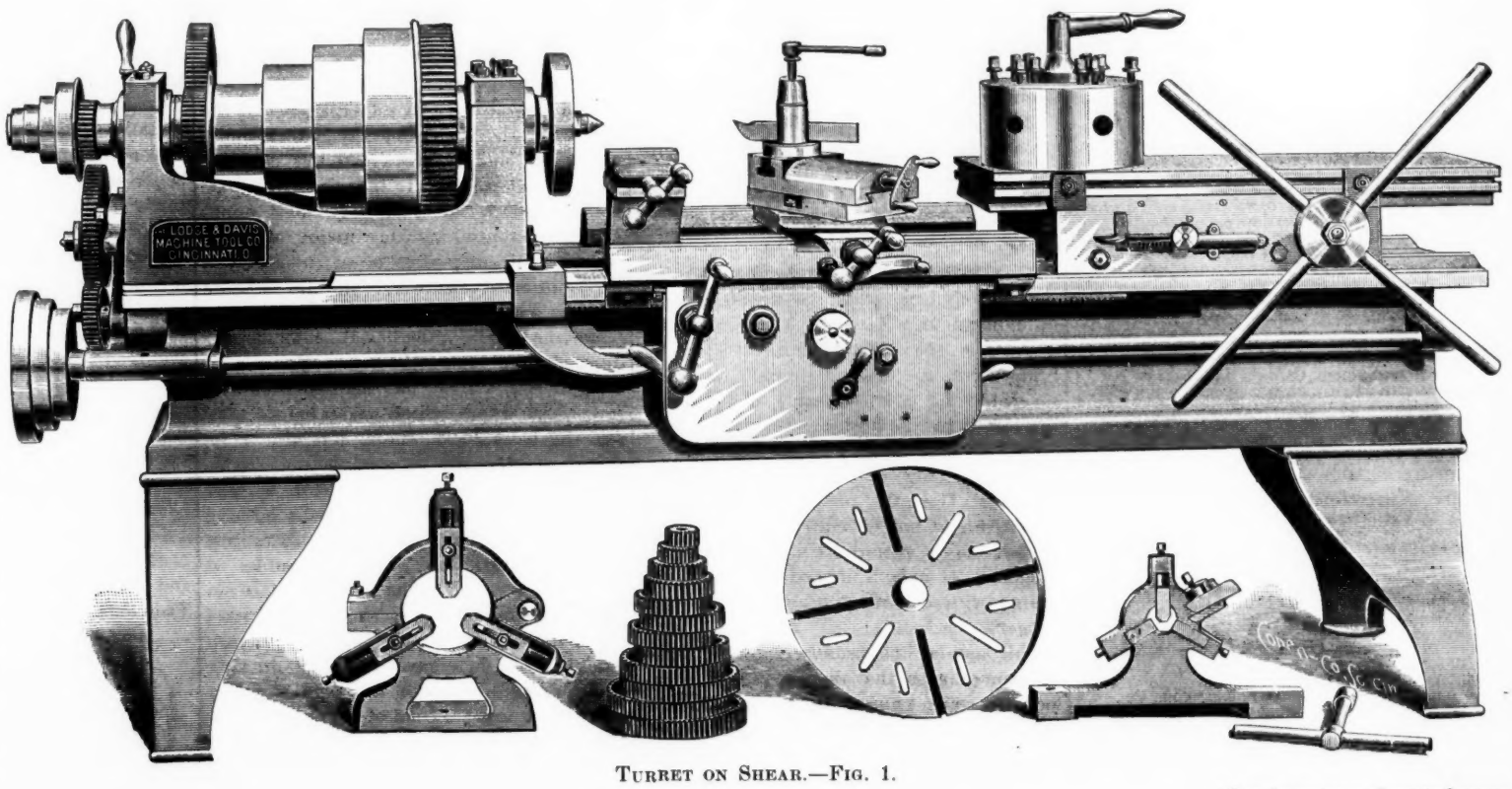
81.—THE ROLLED CURVE METHOD.

It happens in this case only, that the rolled curve method, which theoretically applies to all odontoids, can be actually put into practical use, for the generating roller is here the circle, the simplest possible curve.

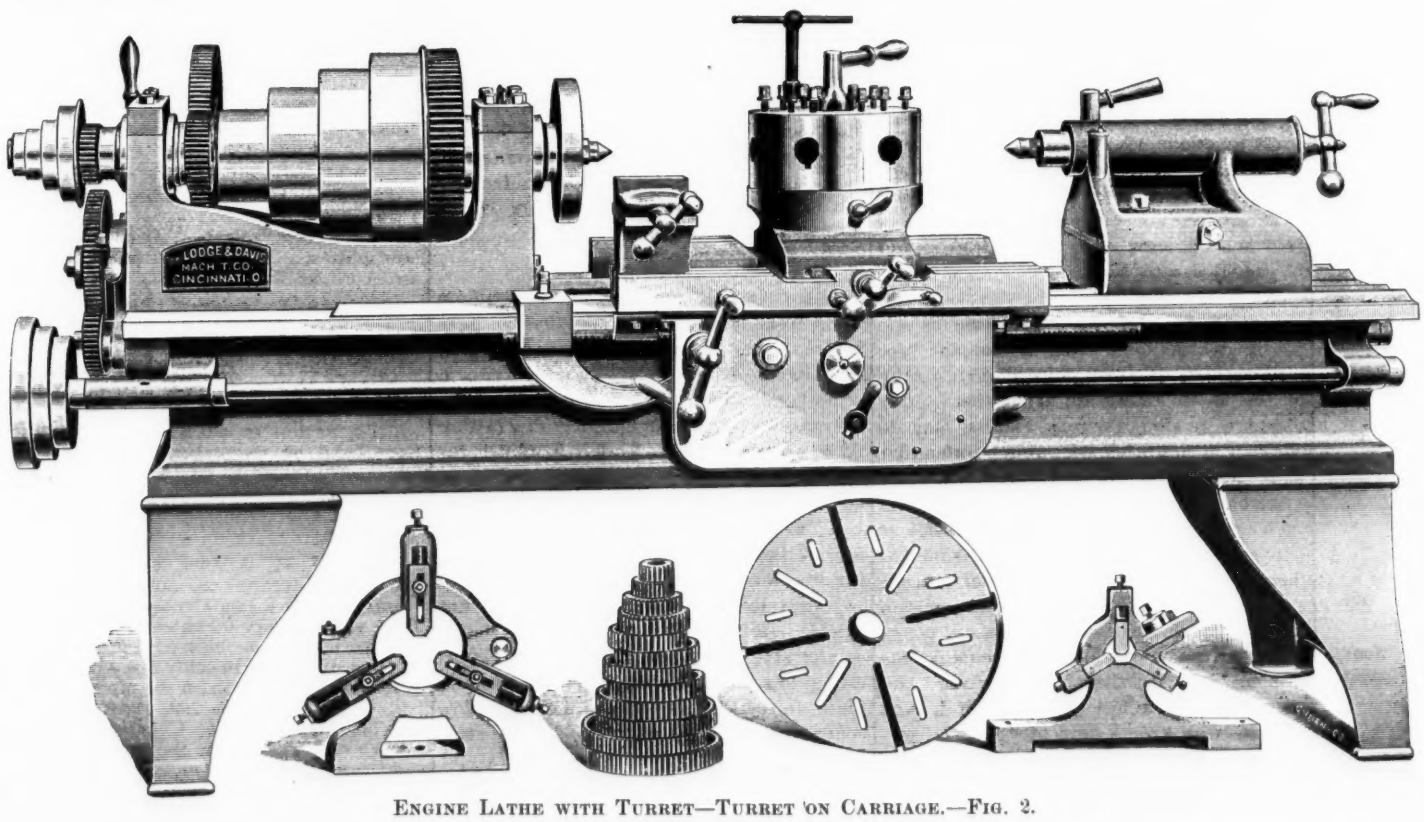
As in Fig. 59, roll a circle of the diameter of the circle of action upon the outside of the pitch line for the faces, and upon the inside for the flanks, and a fixed point in it will trace the curve.

The method can be used by actually constructing pitch and rolling circles, but the same result can be reached more easily and quite as accurately by drawing several circles, and then stepping from the pitch point along the pitch line, and back on the circles to the desired point. If the length of the step is not more than one-tenth of the diameter of the circle, the error will not be over one-thousandth of an inch for each step.

This method is the best one to adopt, except for the standard tooth.



TURRET ON SHEAR.—FIG. 1.



ENGINE LATHE WITH TURRET—TURRET ON CARRIAGE.—FIG. 2.

Engine Lathes with Turret.

On this page we give illustrations showing the manner in which turrets are now applied by the Lodge & Davis Machine Tool Co., of Cincinnati, to their regular engine lathes. This is done in two ways, as shown; Fig. 1 showing the turret as applied in place of the regular foot-stock, the block being made to fit the shears, and the slide worked by a pilot wheel in the ordinary manner, the turret revolving by hand or automatically, as may be desired. Turret has six holes, each having two set-screws for holding tools.

Fig. 2 shows the same lathe with a turret fitted to the cross-slide. In this case the block on which the turret rests is made interchangable with the compound rest, and the change from one to the other is very readily made. In this case, of course, the turret partakes of all the motions and feeds of the carriage, both feeds being automatic. A stop is provided, by which it is brought exactly to the center, in case boring is to be done. With the turret mounted in this way, part of the tools used may be for boring and threading, while others are for facing, counterboring, etc., or several tools may be fitted for performing successive operations upon a piece of work held upon the centers, thus faciliating some kinds of work very much.

In addition to the turret features, each lathe is complete with taper attachment, automatic stop to the carriage feed, compound rest, full swing rest and hollow spindles. The screw is on the inside under the front V, and the half nuts take hold of screw directly under the cutting tool.

Turrets can be applied in this way to lathes of any size, and all the essential features of the lathe retained for ordinary engine-lathe work.

Throwing Dynamite by Powder.

Dr. Joel G. Justin, of Syracuse, who has conducted several successful experiments in throwing dynamite shells by powder from an ordinary gun, using in the experiments a small gun with a charge of two pounds of powder, met with a disaster on the 27th, in attempting to fire such a shell from a nine-inch Blakely rifle, purchased, for experimental purposes, of the South Boston Iron Works. At the first trial the shell exploded within the gun, which was torn to fragments, though fortunately without seriously injuring any one. The accident does not prove, we think, that Dr. Justin's system is necessarily a failure, though of course there will always be more or less risk in attempting to impart to a shell containing dynamite a sufficient velocity within the length of an ordinary gun. The following description of the shell we take from the New York *Times*, which contained an account of the accident:

"This instrument of destruction is a combination of two shells, one suspended within the other. The outer one is of cast-steel and tubular in form, and is provided with a breech-piece. The inner cylinder is an ordinary piece of wrought brass tubing, one-half the length of the outer shell, and having a thin steel cap fitted at either end. It has no metallic connection with the outer one, elastic washers being employed to prevent such contact.

"Within the inside cylinder, and fitting closely to it, are placed wooden boxes containing dynamite, the number varying according to the size of the shell and the quantity of the explosive it may be desired to use. These boxes are charged substantially in this manner: A layer of 'kieselguhr' or other compressible absorbent is placed in the bottom of the box; then a stick of the explosive is cut off to the desired length and placed centrally in the box. The space between it and the cover of the box is also filled with the absorbent. The boxes communicate with each other by means of central openings. When the boxes of dynamite are in place the steel caps of the brass cylinder are screwed on. These caps are furnished with leather air cups, one on each end, in each of which is a vent through which the air in the head of the shell slowly escapes, allowing the tube containing the dynamite to run slowly down to the point, where it is held in place by a small steel wire, fastened over a sharpened bearing. This leaves the rear half of the outer shell entirely empty save of air.

"When the shell receives the impetus of the firing charge of the cannon the wire is instantly broken, and the inner shell should, according to the inventor's theory, go unexploded to the rear. It did not do so to-day. The air in the back chamber forming an air cushion, being displaced through the vents in the leather air cups, should then, according to Dr. Justin, rush to the space left in the forward end by the inner shell as it works backward. The fact that the inner shell is free to move backward and forward slowly, and is supposed not to be subject to the vibrations caused by the explosion of the powder behind it, through the entire absence of metallic connection, is the secret of the alleged non-explosion of the dynamite. The point of the shell, though heavily weighted to insure a perfect balance when the cylinder containing the dynamite is at the rear, is of very thin metal, and is easily broken when it strikes any resisting surface. The collapse of the head explodes the dynamite."

The opinion was expressed before the trial that the shell was too thin and light for the charge, and it is probable that other trials will be made with heavier ones.

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The Buffalo News Co., Buffalo, N. Y.
The Central News Company, Philadelphia, Pa.
The Cincinnati News Company, Cincinnati, Ohio.
The Cleveland News Company, Cleveland, Ohio.
The Colorado News Company, Denver, Colorado.
The Detroit News Company, Detroit, Mich.
The International News Company, New York, N. Y
The Minnesota News Company, St. Paul, Minn.
The Montreal News Company, Montreal, Canada.
The National News Company, New York, N. Y.
The Newark News Company, Newark, N. J.
The New England News Company, Boston, Mass.
The New Orleans News Company, New Orleans, La.
The New York News Company, New York, N. Y.
The Northern News Company, Troy, N. Y.
The Omaha News Company, Omaha, Neb.
The Pittsburgh News Company, Pittsburgh, Pa.
The Rhode Island News Company, Providence, R. I.
The San Francisco News Co., San Francisco, Cal.
The South West News Company, Kansas City, Mo.
The St. Louis News Company, St. Louis, Mo.
The Toronto News Co., Toronto, Ontario, Canada.
The Union News Company, New York, N. Y.
The Washington News Company, Washington, D. C.
The Western News Company, Chicago, Ill.
The Williamsburgh News Co., Brooklyn, E. D., N. Y.

NEW YORK, JUNE 12, 1890.

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An Open Drawbridge—A Suggestion.

A distressing drawbridge accident is reported from California, where a train ran into an open draw, the engine and one car going down, and drowning fourteen people. Means have been devised by which such accidents as this are made practically impossible, and it is incredible that the management of any railroad having a drawbridge in the line, can be unaware that means exist for making that bridge as safe as any bridge of any description can be made.

Not enough of the details concerning this accident are at hand to enable us to specify just the particular point at which failure took place in the operation of such protective devices as were in use there, but it is quite certain that the best of such devices were not in use, or the accident could not have occurred.

According to the press dispatches, passenger trains go over this bridge every half hour during the day, and the man in charge of it was supposed to raise a red flag on a pole above the bridge, as a signal that the draw was open.

This, if it was all the protection afforded, was entirely inadequate. A signal, intended to indicate to a locomotive engineer that a draw is open, should not be upon the bridge, but at a distance from it, sufficient to enable the heaviest trains to be stopped between it and the bridge. Thus the danger of failure to see the signal until too late, on account of fog or other obstructions, is avoided. Then the proper setting of the signal should not depend upon the bridge tender, but it should be automatic—so arranged as to make it impossible to open the bridge without first setting the signal at danger.

This may be, and usually is accomplished by arranging so that the levers which unlock the rails preparatory to opening the bridge, also set the signal at the same time.

Another very good practice is, to require all trains to come to a full stop at some distance from a draw, no matter how the signals may be set; but sometimes, when a locomotive engineer undertakes to stop, he finds that, for some reason, he cannot do so, and that for the time being the engine is out of his control. Nothing will then avail to avert a serious and probably terribly fatal accident, except a derailing switch. This is the last resort when all else fails, and as it will certainly prevent any train from going into an open draw, every such bridge should be provided with them.

We do not thus specify the various means by which drawbridges may be made safe for the information of railroad men, for there is no need of it; every railroad man worthy of the name knows all about them. Our object in detailing them is, that we may do our part in educating the public—unfamiliar with such matters—to know that means are available by which it may be protected from such accidents, and that, when such accidents happen, some one is directly responsible for them, and for the loss of life attending them.

When the public fully understands to what extent such accidents as this and others which occur on railroads are preventable, the responsibility for them can be fixed, and some one made to feel the weight of it, and any one who knows how they can be prevented, and fails to raise his voice in protest against their needless repetition, fails to perform a plain duty. An improperly protected drawbridge in a railway line is nothing more nor less than a death trap, and the first condition imposed for the use of such bridges should be that every known appliance for rendering them safe should be employed.

In this connection it has occurred to us that there is a large field of useful employment for the various organizations of railway employes. Their members are interested in securing the universal adoption of safety appliances more than any other body of citizens, while at the same time they are in position to, and do possess a better knowledge of the defects of the bad and the advantages of the good devices than any others. They already possess the organization, through which accurate knowledge of the condition of every road can be known, and influence brought to bear in the direction of correcting deficiencies. We can think of no new direction in which their power and energy could be exerted, that would be productive of more good, or would more certainly secure for them the friendship of the public, than to have it known that they had taken an active part in lessening the number of fatal accidents to travelers, by securing the adoption and use of the best appliances. While there may be good reasons why such organizations should not take part in such work, we can think of none, and the matter is at least worthy of attention.

A Narrow Escape.

By way of contrast to the story of the drawbridge accident referred to elsewhere, we may mention the recent experience of the new transatlantic steamer, the Normannia, which, on her first voyage to this country, encountered an iceberg in such a way that, had she been without the very latest appliances for controlling the motion of ships, would in all probability be at this time at the bottom of the sea. She was running along at a speed of 17½ knots through a fog, when the officer on the bridge suddenly saw dead ahead a mammoth berg. He was too close to stop, but by the manipulation of a few small levers which stood before him, put the helm hard a-port, and almost instantly stopped and reversed the port engine with its screw, causing the ship to veer off so quickly as to escape with nothing more serious than a few bent plates just under the turtle-back, and the loading of several tons of ice on the deck. It does not seem probable that any single-screw vessel could have been turned out of her course quickly enough to have avoided a crushing collision, and even with the twin screws it seems that every second of time gained by having the appliances on the bridge for reversing either engine, directly and without calling on the engineers to do it, was urgently needed.

The efforts now being made to render ocean travel safe and comfortable appear in strong contrast to the course of most of our railroads in similar directions. But then all the steamship companies make use of the same highway which is free to any who choose to make use of it, and the line which offers the greatest safety, other things being equal, will have the choice of the traffic.

Jersey City is right across the Hudson River from New York; a fact that we have before stated. It is a city of—well say 175,000 inhabitants—with possibilities of growth almost unlimited. There are within its limits some of the best building sites within fifty miles of New York. Facilities for reaching these building locations are good, and are being improved from year to year. But the growth of Jersey City is unsatisfactory to the inhabitants. There are good living locations for mechanics who work in over-crowded New York, but they will not avail themselves of the opportunities to secure comfortable semi-suburban homes. It is interesting to reason why this is so. In the first place, Jersey City is burdened with foolishly contracted debts that make taxes high. But these debts are a thing of the past, and could be easily enough taken care of. There is a more potent reason than this why people live elsewhere than in Jersey City. The water that supplies the city is taken from the Passaic River, and is most thoroughly contaminated with sewage. And this contamination is being increased with the growth of cities along the river banks. There is abundance of good water within reasonable distance of the city, but it will cost something to get it. So the city goes, relatively, to decay. People will not live there, and manufacturers shun it. In the view of present knowledge, no city or town need expect to prosper that does not provide good water. It is a better thing than big bonuses to manufacturers, or the giving away of building lots to start a "boom."

Literary Notes.

PAVEMENTS AND ROADS: Their Construction and Maintenance. Reprinted from *The Engineering and Building Record*. Compiled by E. G. Love, Ph. D. *The Engineering and Building Record*, New York.

It would not be possible to improve upon what is said in the preface to this book in the way of giving an idea of its scope. We therefore quote as follows:

"This book is a compilation of articles which have appeared in recent volumes of *The Engineering and Building Record*, edited with a view of eliminating whatever was of timely or local interest, and arranged by divisions for convenience of use.

"The science of paving and the need of proper maintenance of pavements is yet comparatively little understood in this country, and the same is true in even greater degree with regard to roads. The editor of the journal named was led to give the matter special attention by seeing what was done in Europe, during his visits there, and finally began an investigation of work on streets and roads in England, France and other countries, the result of which was the gathering of a large and very valuable mass of information in regard to the subject. Of this everything likely to be of practical use in America was printed in *The Engineering and Building Record*, and is given here in more convenient shape. With it appears a large quantity of matter from American sources, including the prize essays on Road Construction and Maintenance submitted in the competition instituted by the journal named, in December, 1889.

"It will be seen that the great bulk of the book is made up of records of experience and statements of cost in different places. The comments are based on this experience."

Questions and Answers.

Questions of general interest relating to subjects discussed in our columns will receive attention in this department. The writer's name and address should always accompany the question. Neither correct initials nor location will be published when there is a request to that effect. If questions are enclosed with a business communication, they should be written on a separate sheet.

(221) J. H. H., Lorain, Ohio, writes: I am a young machinist, but do not know how to set locomotive valves. Please inform me how to do so. *A.*—See AMERICAN MACHINIST, April 30, 1887, page 5.

(222) H. S. T., Corinth, Miss., writes: I wish you would inform me which is the front cylinder head on an ordinary stationary engine. *A.*—The fly-wheel end of a stationary engine is generally considered to be the front end of the engine, hence the cylinder head which is nearest to the crank is called the front head of the cylinder. Sometimes a little confusion arises on this point, because in locomotives the head which is furthest from the crank-pin is called the front cylinder head.

(223) E. P. P., Atlanta, Ga., asks: Will you kindly inform me how I can braze a brass ferrule to a small copper pipe? *A.*—The end of the pipe to which the ferrule is to be brazed must be cleaned thoroughly by filing or dipping it in acid; place the ferrule in the correct position on the pipe, and heat both over a fire; when hot allow spelter to run between them. 2. I have a boiler with a leaky stay bolt above the fire-door. How can I stop the leak? *A.*—Take out the stay bolt and put in a new one.

(224) H. C. B., Plainfield, N. J., asks: What is the theory for placing steam heating pipes overhead? *A.*—The system of warming overhead by direct radiation is one of convenience and necessity more than choice of position. It is claimed that less pipe will warm a building in this manner than if it were placed against the walls low down. In some cases it is very doubtful whether, with the overhead system, pipes can be saved, and it would require actual experiments to determine the result. Your other questions are out of our line.

(225) G. T., Mexico, New York, writes: In a discussion in which several mechanics took part, they differed so materially in their views as to the proper method of annealing brass tubes previous to placing them in the tube sheet that they agreed to have the matter decided by you. *A.*—One method is to

heat the tubes and then plunge them in water. Another method is to heat the tubes in a furnace specially built for the purpose, and then let them cool gradually in the furnace. Both methods will anneal the flues; the first one will answer when the work is in a hurry, the second is the best and safest one.

(226) W. L. R., San Francisco, Cal., asks: At what temperature does salt water freeze? *A.*—Sea water which contains several different salts dissolved in it, chiefly common salt, freezes at 27.4° Fahrenheit, the salt separating, and the pure water floating in the form of ice; and water which is saturated with sea salt sinks as low as −4° Fahrenheit before freezing. Pure water freezes at 32° Fahrenheit, or we may say that the freezing point of pure water is stationary at 32°. 2. At what temperature is pure water at its largest bulk? *A.*—At 32° Fahrenheit. If water at the temperature of 39.1° be either warmed or cooled it expands. This temperature is therefore called the point of maximum density of water. If we consider water at this temperature to occupy a volume of 1, it will occupy a volume of 1.000127 at 32°; and the volume of ice at 32° will be 1.0908.

(227) Felix, Paterson, N. J., writes: I would like to know how to run a Frick ice machine. I am a practical machinist, but have never run any engine. Where can I obtain the necessary instructions to enable me to learn all about running an engine, specially an ice machine? *A.*—A practical machinist with a fair public school education should have no trouble in running a stationary engine. Of course, in many States you will need a license, and to obtain this you will have to pass an examination. We should therefore advise you to apply for a license, and, if you cannot pass the examination, you will have the advantage of knowing in what branches of study you are deficient, and it will point out to you the course of study to pursue in your leisure hours. We do not know of any institution which makes stationary engine running a special study. In order to learn how to run a Frick ice machine we should advise you to seek employment in an establishment where these machines are being built, and, if you prove yourself to be a capable person, you may obtain the desired position.

(228) E. P. P., Washington, D. C., writes: F. A. Halsey, in his treatise on slide valve gears, and under the head of eccentric, defines the throw of an eccentric as the distance from the center of shaft to the center of eccentric disk. Again, in an issue of the AMERICAN MACHINIST dated September 29, 1888, and in reply to Question 427, it is stated that the travel of the valve is equal to the throw of the eccentric, that is to say, equal to twice the eccentricity of the eccentric. Now in my opinion the above statements conflict, and what I am desirous of knowing is, which is right? *A.*—It is unfortunate that authors do not give the same definition to the term "throw of an eccentric"; some define it as the eccentricity of the eccentric, and others as twice that amount. The latter definition is generally given by English authors, and American authors tend to adopt the former. But in the majority of American shops the whole linear travel of an eccentric is called its throw, and this definition we have been accustomed to follow. So far as we can make out, mechanical writers are pretty evenly divided in their definitions of the subject. But when authors define their terms clearly, as Mr. Halsey does, a difference in the definitions should not detract anything from the value of the work.

(229) J. C., Louisville, Ky., writes: Please inform me what thickness of metal will be required for a lap-welded iron pipe 7 inches diameter, to stand 160 pounds steam pressure? Also what should be the thickness of a copper pipe of the same dimensions? Please give rules for computing the same. *A.*—For pipes subjected to internal pressure we employ the following formula:

$$T = \frac{P \times R}{C} \qquad (1),$$

in which T denotes the thickness in inches of the metal; P, the pressure per square inch; R, the internal radius in inches; and C, a constant depending on the kind and quality of the material used. Adopting a factor of safety of 8, we take for the value of C one-eighth of the ultimate tensile strength of the metal; assuming that the ultimate tensile strength of iron is 40,000 pounds per square inch, we have for the value of C

$$\frac{40,000}{8} = 5,000.$$

Now substituting in formula (1) for the symbols their values, we have

$$T = \frac{160 \times 3.5}{5,000} = 0.112,$$

say $\frac{1}{9}$ of an inch, which is the thickness of the metal of an iron pipe 7 inches inside diameter subjected to an internal pressure of 160 pounds per square inch. If the pipe is made of copper we employ the same formula, but of course we must assign the proper value to C. Assuming that the ultimate tensile strength of copper is 24,000 pounds per square inch, and again adopting a factor of safety of 8, we have for the value of C

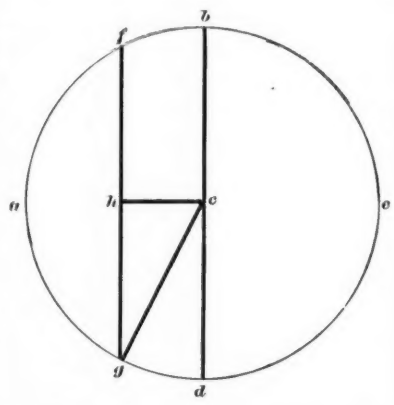
$$\frac{24,000}{8} = 3,000.$$

Substituting in formula (1) for the symbols their values, we have

$$T = \frac{160 \times 3.5}{3,000} = 0.1866,$$

say $\frac{3}{16}$ inch for the thickness of a copper pipe 7 inches inside diameter, and subjected to an internal pressure of 160 pounds per square inch.

(230) A. G. G., Providence, R. I., writes: Please inform me how to find the length of a chord of a circle when its distance from the diameter is given. For example, the diameter of the circle is 3 inches; distance from the diameter to the chord, .2 of an inch; what is the length of the chord? *A.*—Square the given distance from the diameter to the chord, also square the radius of the circle; subtract the former from the latter, and extract the square root from the remainder, and multiply the result by 2. Thus the square of .2 is .2×.2=.4; the square of the radius is 1.5 × 1.5=2.25. And 2.5 −.4 = 1.85 The square root of 1.85 is 1.36, and 1.36 × 2 = 2.72 inches, which is the length of the



required chord. The foregoing rule is based on the following principles: Let *a b d e* represent the given circle, *f g* the chord. Through the center *c* of the circle draw *h e* perpendicular to the diameter *b d*, and draw the radius *c g*. Here then we have a right-angled triangle *c h g;* the lengths of two of its sides, *c h* and *c g*, are known, hence the side *h g* is found by subtracting the square of *c h* from the square of *c g*, and extract the square root from the remainder, which will be the length of *h g*. But *h g* is one-half of the required chord, hence twice *h g* will be the length of the chord.

BUSINESS SPECIALS

Transient Advertisements 50 cents a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Thursday for the ensuing week's issue.

Lexington Cut Iron Gears. See adv. on p. 20.

Link-Belting and Sprocket Wheels.

Send for Catalogue of Link-Belting.

Over 50,000,000 feet of Link-Belt in use.

Link-Belt Engineering Co., Philadelphia and N.Y.

Shafting Straighteners. J. H. Wells, Tampa, Fla.

Mech'l Drawings; best; cheap. Box 457, Reading, Pa.

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Davis Key-Seating Machines kept in stock by Manning, Maxwell & Moore, 111 Liberty st., N. Y.

The best Upright Hammers run by belt are made by Jenkins & Lingle, Bellefonte, Pa.

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Universal Vise Chucks. Pedrick & Ayer, Philadelphia, Pa.

Link Planer Attachments. Pedrick & Ayer, Philadelphia, Pa.

Standard Tool Co.'s Twist Drills. S. A. Smith, 23 S. Canal st., Chicago, Western Representative.

Light Special Machinery and Tools to order. The Meriden Machine Tool Co., Meriden, Conn.

Steel Name Stamps, etc. Address W. G. Sackmann, 1099 First ave., Cleveland, O.

Get particulars of our new Wall, Suspended and Radial Drills. C. H. Baush & Sons, Holyoke, Mass.

Audubon Machine Works, New Haven, Conn. Special machinery, heavy and light.

Well-drilling Machinery and Tools. Williams Brothers, Ithaca, N. Y.

For Pattern Letters, Steel Stamps, Burning Brands, Mach'y, Plates, &c., A. A. White & Co., Prov., R. I.

F. C. & A. E. Rowland, New Haven, Conn. Hydraulic, Mill and Special Machinery to order.

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For the Latest Improved Diamond Prospecting Drill, address the M. C. Bullock Mfg. Co., 138 Jackson st., Chicago, Ill.

Send $1 for Catalogue D, Fine Tools and Supplies. Over 550 pages. Fully illust'd. Free when $10 worth goods are ordered. Frasse & Co., 92 Park Row, N.Y.

Curtis Pressure Regulators. Curtis Return Trap. Curtis Damper Regulator. See June 5, p. 18. Send for circular No. 17. Curtis Reg. Co., Boston, Mass.

Guild & Garrison, Brooklyn, N. Y., manufacture steam pumps, vacuum pumps, vacuum apparatus, air pumps, acid blowers, filter press pumps, etc.

Split Pulleys at low prices, and of same strength and appearance as Whole Pulleys. Yocum & Son's Shafting Works, Drinker st., Philadelphia, Pa.

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25" } "Only Drill Press built on
32" } 'Ko-rekt' principles,
37" } even if they come from Jersey."
42' } Gould & Eberhardt, New Ark, N. J.

C. H. Redman & Co., Newark, N. J., Manufacturers of Light Machinery, Automatic Selling Machines, Telephone and Telegraph Instruments, Sewing Machine Attachments, Models, etc. Contracts solicited.

For Sale—Bound volumes of the Patent Office Gazette for years 1883, 1884, 1885, 1886, 1887 and 1888. Price, $4 per year. Address J. C., care of AMERICAN MACHINIST.

Every draftsman needs one. The Engineer's Sketch Book of mechanical movements, appliances, devices, contrivances, etc., by T. W. Barber. 1,936 illustrations, 8vo. cloth, $3. Catalogue of books on mech. subjects free. E. & F. N. Spon, 12 Cortlandt st., New York

Montgomery & Co., 105 Fulton st., New York City, have just issued a small catalogue of 160 pages, containing description and prices of many useful tools. A copy will be sent free to any address upon application.

De Lamater Screw Propeller Wheel made only by The Samuel L. Moore & Sons Co., Elizabethport, N. J., who have purchased from C. H. De Lamater & Co., New York, all their patterns, books of record, gauges, etc. Location and equipment well adapted for Heavy Steamship Repairs.

Stub Ends and Connecting
Rods for small connections.
Especially adapted for Valve
Rod for Steam Engines.
T. C. Dill Machine Co.,
Philadelphia, Pa.

"Binders" for the American Machinist. Two styles, the "Common Sense," as heretofore sold by us, and mailed to any address at $1.00 each, and the "New Handy," mailed at 50c. each. The former has stiff board covers, while the latter has flexible covers with full page opening flat. Either will hold the entire 52 issues of any volume. American Machinist Publishing Co., 96 Fulton st., New York.

Just concluded. "Practical Drawing." By. J. G. A. Meyer. Copies of the American Machinist containing the above series of 93 articles sent by mail to any address in the U. S., Canada or Mexico, for $4.65, or single copies 5 cents each. American Machinist Publishing Co., 96 Fulton st., New York.

Screw Propellers.
Manufactured by H. B. Roelker,
22 Cortlandt st., New York.
Superintendent of the late De Lamater Iron Works, of same patterns and designs as before, adapted to each vessel. Consulting Expert and Constructing Engineer. Estimates on machinery, damages, etc. Air ice machines.

Just concluded. "Modern Locomotive Construction." By J. G. A. Meyer. The above series of 106 articles, which have attracted so much attention everywhere, is now concluded in newspaper form. Copies of the American Machinist containing the entire set sent by mail to any address in the U. S., Canada or Mexico for $5.30, or single copies 5 cents each. American Machinist Publishing Co., 96 Fulton st., New York.

"Indicator Practice and Steam Engine Economy." By F. F. Hemenway. Contains plain directions for using the indicator and making all required calculations from the diagram; also the principles of economy in operating steam engines and current practice in testing engines and boilers. Price $2, postpaid. Published by John Wiley & Sons, 53 East 10th st., New York.

MANUFACTURES.

A co-operative cotton mill is to be started at Goldsboro, N. C.

It is stated that a car manufacturing plant will soon be built at Venice, Ill.

The Lua Cotton Mill, with $250,000 cash capital, has located at Bridgeport, Ala.

A $50,000 stock company is being formed at Clayton, Ala., to erect a cotton mill.

A $1,000,000 cotton mill is to be erected at Highland Park, near Montgomery, Ala

The Valley Iron Works, of Williamsport, Pa., will remove their plant to Lynchburg, Va.

A $10,000 steam brick plant and a large blast furnace will be located at Covington, Va.

Gadsden, Ala., reports the organization of a bar and steel mill company. Capital, $150,000.

The Chattanooga Pipe and Foundry Company will build branch works at Bridgeport, Ala.

A. C. Robinson has formed a stock company at Bridgeport, Ala., to erect a 100-loom woolen mill.

Boston capitalists will build a cotton mill at Chattanooga, Tenn. The building will be 100x100 feet.

The Golden Foundry and Machine Company at Columbus, Ga., will erect new plant and enlarge capacity.

It is reported that a wire mill is to be located on the property of the New Rome Land Company, at Rome, Ga.

A stock company, with $100,000 capital, has been organized at Graham, Va., to erect a furniture factory. A. B. Nicholls is president.

The Sullivan Iron Co., of Duluth, Minn., with capital stock of $50,000, has filed articles of incorporation with the Secretary of State.

It is reported that the North Vassalboro Woolen Mills at Maine will soon be shut down and the plant and machinery offered for sale.

The mayor of Cleburne is in correspondence with parties who propose locating in Cleburne, Texas, boiler works and a $25,000 brick plant.

The old looms are being removed from the weave-room of the Manville Mills, R. I., and will be replaced by new and improved machines.

The Eggette Fuel Company has been incorporated at Richmond, Va. Capital stock, $100,000. It will manufacture an artificial fuel from culm coal.

A New England syndicate has recently organized, to expend $1,000,000 in Laredo, Tex. Among other enterprises the syndicate will erect a cotton mill to employ 500 hands.

Drake & Smith are making extensive repairs on their saw-mill at Bristol, Vt. This firm is doing a large business in the manufacture of mailing boxes, etc., and are crowded with orders.

The Dowdy Manufacturing Co., of Augusta, Ga., has been incorporated by W. H. Dowdy, C. W. Davis, W. B. Sprague and others, to start a yarn and hosiery mill. The capital stock is $50,000.

Laredo, Texas, offered to donate five blocks of land to anybody who would build a cotton mill to cost $100,000. Mr. J. L. McVicker, of New York, has accepted the offer, and the mill will soon be built.

The Lodge & Davis Machine Tool Co, Cincinnati, Ohio, writes: "We have just sold the Sioux City & Northern Railroad Co. an entire machine shop outfit, the plant to be located at Sioux City, Iowa."

The American Zinc Lead Company has been organized at Portland, Me., with a capital stock of $5,000,000, of which $100,000 has been paid in. The company is to run large smelting works in Colorado.

Improvements are being made in the plant of the Lockwood Mills at Waterville, Maine. The Lewiston Machine Company has a contract to supply 154 wide looms to this mill. This will make a total of 2,354 looms.

An English syndicate, with $3,000,000 capital, has been formed to develop the mineral lands of northern Alabama. Already furnaces, foundries, flouring mills and other large industries are in progress of completion.

The Buffalo Steam Forge Co., of Buffalo, N. Y., has leased the Cayuta Forge and Axle Company's Works at Sayre, Pa. This action was necessary on account of the recent large orders for car and locomotive axles.

The Texas Mining and Improvement Company has a proposition from Northern capitalists to put in a cotton mill at Marble Falls, Texas, as soon as the water-power is developed, and take the major portion of the stock.

The Bridgeport Woolen Mills is a $125,000 stock company that will establish a woolen mill at Bridgeport, Ala. It will erect a two-story building, 46x26 feet, an ell 70 feet square, and additions for boiler-room, dye-room, etc.

The Berlin Iron Bridge Company, East Berlin, Conn., has issued a very complete circular of iron bridges and other iron structures built at the works. The catalogue is a large one, and is very completely illustrated.

A contract has been closed with the Railroad and Improvement Company, of Florence Ala., to locate a large foundry for the manufacture of stone fronts, architectural iron castings, etc., at that place. The plant will cost $100,000.

Articles of incorporation have been filed with the Secretary of State of Minnesota, by the Eureka Stone Company, of St. Paul. Capital stock, $10,000. The incorporators are Warren Carpenter, Carl H. Park and Frank E. Foster, all of this city.

Articles of association have been filed with the Secretary of State of Wisconsin by the West La Crosse Lumber Company, of Campbell, La Crosse County. Capital stock, $18,000. Incorporators, John Rau, John C. Scholler and John Rau, Jr.

E. W. Thompson, who has been interested in the cotton oil business in the South for some years, has secured an interest with Forbes, Liddell & Co., Montgomery, Ala. The company do a general supply business, and look after engineering matters.

A corporation has been formed at Springfield, Mass., with a capital stock of $10,000, to manufacture the Bartlett automatic elevator gate. Officers are: President, F. K. Bartlett; treasurer, W. F. Hurd; directors, these officers with F. A. Bartlett.

The Rambler Roller Compress Company, of Galveston, Texas, with a capital stock of $100,000, has filed a charter. Also the Harrisburg Manufacturing Company, capital $30,000, to manufacture axe and hoe handles, wooden-ware and agricultural implements.

There is a very good prospect that Dexter, Maine, will have a new and important industry. A new and quite large machine shop is to be erected, and will be occupied by A. B. Pitkin, the well-known manufacturer and dealer in machinery now located at Providence, R. I.

Keuffel & Esser Co., New York, are making extensive additions to their shops at Hoboken, N. J. They have brought out some new steel tape measures, both for long and short measurements, that possess excellent qualities both for ease of operation and clearness of graduation.

The Wisconsin Lumber Company contemplates the erection of a saw-mill at Rhinelander, Wis., to cut the timber on large tracts in Oneida County and in Michigan, recently purchased from Wright & Ketcham, of Saginaw. The logs will be railed to the Wisconsin and driven to Rhinelander.

The Eagle Pencil Company, of New York City, is the purchaser of the Bowen Pencil Factory at Gurley, Ala. It will erect new buildings and put in additional machinery. The main building will be two stories, 65x100 feet. The company will also operate a machine shop.

Maxwell & Vincent have secured three acres of land in the eastern suburbs of Springfield, Ohio, and will cover about half of it with buildings for carrying on the steel casting business, using the crucible process. They intend to be making castings before the middle of June.

The Long Island Cotton Mill, of Monbo, N. C., formerly operated by James Brown, has been incorporated, with a capital stock of $35,000, by G.H. Brown and J. S. Ramsay, of Statesville, and James Brown. The company will add 1,000 spindles with necessary machinery, and an electric light plant.

A stock company has been organized in Springfield, Mass., to manufacture the Bartlett automatic elevator gate. The capital stock of the company is $10,000, and it is organized under the name of the Bartlett Automatic Gate Company, with F. K. Bartlett president, and W. F. Hurd, of Bridgeport, Ct., treasurer.

The Porter Foundry and Machine Company, of Pittsburgh, Pa., is building a 50x50 foot addition to its foundry, and will soon make further additions, all of which will be fitted out with modern improvements and operated by steam power. The company is behind in orders, never having known a busier season.

The Greenway Lumber Company, capital stock $16,500, divided into 165 shares of the par value of $100 each, has been incorporated at Kansas City, Mo. Charles Hammett and John H. Tschudy own fifty-four shares, John L. Lane fifty-five, and L. E. Davison and William Huttig, Jr., one share each of the capital stock.

Samuel T. Williams, Baltimore, Md., writes us: After a dull winter we are having quite a revival of trade. My small vertical engines are in demand, and we are building a number of them—all for electric lighting. We are compelled to work at night to catch up with orders. The demand is for four, eight and twelve horse-power engines.

It is understood that W. J. Hammond, formerly of the old Pittsburgh Forge, Second avenue, has closed the purchase of ten acres at Mansfield, Pittsburgh district, and will proceed at once to erect a mill, which will include a tin plate plant. Hammond was presented by the residents of Mansfield with five acres. With the fifteen acre plot he has room to spread himself.

The mill now being erected at Fall River, Mass., for the Kerr Thread Co., of Newark, N. J., will be 125 feet wide, 96 feet long, and five stories high. The cost will be over $100,000, and the contract requires the mill to be ready for occupancy by Oct. 1. The capacity of the mill at first will be 24,000 to 30,000 spindles, but eventually the company hope to have 60,000 spindles in operation.

A certificate of organization of the Paterson (N. J.) Novelty Ribbon Company has been filed in the County Clerk's office. The capital stock is $75,000, and is divided in 750 shares, of which the par value is $100. The incorporators are Charles E. Meding, of Paterson; Arthur Lemisen, of New York; Frederick Horandt, of Astoria, R. I.; Frederick G. Yorks and Eugene Stephenson.

Thomas Howard and John W. Harrison, of the Shickle, Harrison & Howard Iron Co., of St. Louis, Mo., will build pipe works at Bessemer, Ala. A site has been selected, and contract for excavating and grading awarded. The main building is to be 80x100 feet, and will, with other buildings, storeyards, etc., cover about forty acres of land. Capacity of plant is to be 200 tons per day, and it is expected to commence operations by October 1.

A mammoth new manufacturing plant will be built by the Milwaukee Bridge and Iron Company in Milwaukee, Wis. The main building will be 600 feet long and 100 feet wide. There will also be a second shop, 60 feet wide and 180 feet long, and several smaller buildings for various purposes. Exclusive of new machinery, the plant will cost $175,000. About 200 men are employed in the present plant, but in the new establishment the working force will be increased to about 500.

The woolen mill, shoe factory and other industries at Oldtown, Maine, have resumed operations after a short shut down owing to high water in the Penobscot. There is an excellent prospect at the present time for the establishment of additional industries. A cotton mill and a mill for the manufacture of knit goods are already talked of. The vast power at Oldtown Falls and Gilman's Falls is attracting the attention of manufacturers.

The Citizens Fuel Gas and Lighting Company, of Burlington, Ia., has been incorporated, with a capital stock of $300,000. The incorporators are Messrs. W. D. Gilbert, M. A. Johnson, Chris. Mathes, Chas. Starker, Jas. W. Smither, Chris. Geyer, D. D. Robinson, R. M. Raab, T. W. Barhydt, Philip M. Crapo. The charter of the company runs for twenty years, and it will begin business when one-third of its capital stock is paid in. Fuel gas will be supplied both for heating and incandescent gas lighting.

A big land purchase has just been made at Newburyport, Mass., by the Newburyport & Amesbury Street Railway Company, and a power plant is to be established for running the electric lines of the company in this section. The erection of a brick building is to begin at once—100x70. It will be equipped with a new engine and two large dynamos. The purchase includes 25 acres, and on the space not used for power-house will be erected paint, machine and repair shops. This improvement will necessitate the expenditure of about $100,000.

Amendatory articles of incorporation were filed last Friday, by which the authorized capital of the McCosh Iron and Steel Co., of Burlington, is increased from the present limit of $200,000 to $500,000. This large addition to its stock is rendered necessary by the extensive additions now being made by the company. The additions being made will nearly double the force of men. This is one of the manufacturing industries that is doing a great deal for Burlington, and it now bids fair to become, at no distant day, the largest establishment of the kind in the United States.

At the annual meeting of the Taunton (Mass.) Electric Lighting Company, P. H. Corr was chosen president; Nemus Page, treasurer; Mortimer Westcoat, corporation clerk. Directors: A. G. Williams, P. H. Corr, N. Page, George W. Colby. A dividend of seven per cent. was declared. It was voted to increase the capital stock to $50,000, to build at once a two-story brick building, 50x50, to put in three new engines of 200, 90 and 75 horse-power respectively, the last for supplying motive power, and to change the system of incandescent light to the alternating. Other improvements are under consideration.

A correspondent of the *Troy Times* writes from Amsterdam, N.Y., as follows: "The Amsterdam manufacturers state that the reports going the rounds of the press that the knit goods business is dull, are exaggerated. Most of the manufacturers have orders enough to keep them operating their mills for some months to come. The Morris Mills are now being operated day and night, and with two sets of machinery. The firm has orders enough ahead to run for two years. They are now running on a large Government order. Two sets of operatives are employed. Now the tariff bill has passed, it is safe to say that, so far as Amsterdam is concerned, it will soon be 'booming'—at any rate such are the opinions of the knit goods manufacturers. The Little Falls knitting mills are being operated on full time, and two or three are run day and night. A manufacturer says that all the mills could run day and night if the firms desired to do so."

The Mechanical Engineers.

Last week our report of the Cincinnati meeting of the engineers closed with the discussion of Mr. Nagle's paper on Automatic Sprinklers, following which was a paper by Prof. R. C. Carpenter, entitled Tests of Several Types of Engines, Under Conditions Found in Actual Practice. The paper is much too long to admit of even a fairly complete abstract being printed here, without which the discussion would be without significance.

The paper by the same author on Comparative Tests of a Hot Water and a Steam Heating Plant, gave details of tests of such plants working in greenhouses that were alike and standing together. The results seemed to show that the hot water system was much the more efficient and economical, though Charles E. Emery and C. W. Nason took the ground that the experiments were conclusive only for the given heaters and arrangements generally, and that it could not be concluded from them that hot water heating systems were necessarily more efficient in all cases than steam.

A third paper by Prof. Carpenter, on the use of kerosene in boilers, we published last week.

The rain caused a postponement of the drive about the city, which was to have taken place in the afternoon, and Saturday's programme was taken up in the afternoon, the first paper being by Mr. E. J. Armstrong, entitled, "A Use for Inertia in Shaft Governors," published in full in our issue of May 22. This was followed by a paper on

"A GOVERNOR FOR STEAM ENGINES,"

by Mr. Jesse M. Smith.

The governor, which is the subject of this paper, was designed on the basis of the following propositions:

First.—A governor to be sensitive must be as free as possible of friction.

Second.—To be powerful the forces which are in equilibrium must be large compared to the resistance of the valve to be moved.

Third.—In order that the shaft may not be thrown out of balance by change of position of the governor weights, these weights must be symmetrical.

Fourth.—That the engine may make long runs the joints of the governor must be so constructed as not to require oil, or be capable of lubrication while in motion.

The centrifugal governor has assumed an almost infinite variety of forms, from the fly balls of Watt to the shaft governor of the modern high-speed engine. In all forms, however, the motive power is the centrifugal force of a weight. The centripetal force, which equalizes the centrifugal force of this weight, has been supplied by gravity, by the pull of the main belt, by springs, by inertia rings, and by the centrifugal force of other weights.

Various devices have been added to prevent or modify the "racing" of governors due to too sensitive adjustment or friction in the joints. Air and fluid dash-pots, connected directly and through springs to the moving parts of the governor, have long been used with more or less benefit.

The lamented John C. Hoadley was among the earliest to design a shaft governor in which the valve was actuated as well as regulated by the governor. He has had many followers who have profited by his experience and added their mite, until we have to-day many governors which give excellent results. In every governor the forces are in equilibrium, just as the weights on a scale beam are in balance; and whenever this equilibrium is disturbed by change of speed the parts seek new positions in which they will be again in equilibrium. The ease, and therefore the promptness with which the parts move to a new position depends, not upon the resistance of the valve, nor the friction of the parts which are constantly in motion relative to each other, nor to the weights, nor springs, but to the friction of the parts which were at rest relative to each other. That is, the friction of the joints of the governor proper, beginning at the eccentric disk and ending with the flying weights.

The friction of the valve, valve connections and eccentric strap, taken as a whole, is a variable quantity passing from zero to a maximum and back to zero twice in each revolution. Its mean value, however, is, or may be made, reasonably constant by the modes of lubrication in general use.

The friction of the joints of the governor is quite another force.

With a constant load and steam pressure the parts assume a certain position, and do not leave that position until after a change of load or steam pressure takes place. The parts being in relative rest, they adhere to each other somewhat, and if the oil becomes gummy or scarce, as it may during a long run, they adhere quite firmly. When the change comes, the forces try to overcome this *friction of rest*, but the instant motion begins the friction is greatly reduced, and the forces which overcame the friction are unbalanced, and the weights move way past their proper position. In the effort to overcome the friction the speed has changed from the normal, and when the weights do move they move too far and allow the speed to change in the opposite direction. We then have "racing" more or less severe, according as the joints are well or poorly lubricated. It is this friction of the joints of the governor, and not the friction of the valve and connections, which prevents the use of the isochronous governor, or an adjustment of spring closely approaching isochronism.

In a successful governor for close regulation it is not only necessary that friction of the joints be small when the engine is first started, but that it will remain small during a long run of, say, 200 or 300 hours. It is therefore very desirable that the joints be made so as to require little oil, or be capable of lubrication, positively while in motion.

The governor which is the subject of this paper was designed in 1883, and has been applied to a number of engines with unbalanced as well as balanced valves. It is shown in Figs. 151 and 152.

A small shaft B is journaled in the hub of the Y wheel, and is parallel to the main shaft. The eccentric, whose center is at D, is fixed to one end of the shaft B, and the cross-arm d to the other. The center of the eccentric may thus move about B, across the shaft, and produce the variable valve motion. Each end of the cross-arm d is connected by a link C to an arm c, pivoted at P. The flying weight W fixed to the arm a, also pivoted at P, tends to move outward as the speed increases. It is resisted by a weight E acting on the arm b, also pivoted at P, which moves inward when W moves outward. The spring S, whose axis is radial, also acts on arm b, and assists the weight E to urge W inward. The valve resistance V also assists the weight E. The arms a b c are all formed in one piece. The weights W and E and spring S move as nearly as possible upon radii from the center of rotation. For the purpose of reducing the friction to a minimum, the pivot P, which sustains the greatest strain, and the bearings at the ends of arms b, are made in the form of knife edges of hardened steel. They require little or no oil, and are enclosed, so as not to gather dust. The joints of the links C support little strain, and are usually made simple pin connections. The eccentric being mounted on the small shaft B, which has a long bearing in the hub of the flywheel, requires little force to move it. The shaft B may, besides, be oiled while the engine is running, by means of a small pipe extending from the center of the main shaft to the middle of shaft B, so that the friction here is also reduced to a very small amount. This governor is readily adapted to run in *either* direction. The forces being in equilibrium, we may write the following equations:

$WRN^2 Fa = ErN^2 Fb + Sb + \frac{1}{2} Vc$. Equation (1).

$W R' N'^2 Fa = Er' N'^2 Fb + Sb + \frac{1}{2} Vc$. Equation (2).

In which

N = Maximum revolutions per minute.

N' = Minimum " " "

R = Distance from center of weight W to center of rotation at N rev.

R' = Same at N' rev.

r = Distance from center of weight E to center of rotation at N rev.

r' = Same at N' rev.

S = Tension of spring at N rev.

S' = " " " " N' rev.

V = Resistance of valve and its parts as applied to center of eccentric D.

F = Centrifugal force of 1 lb. 1 inch from center at 1 rev.

The first side of the equations represents the moment of the centrifugal force of W about pivot P. The second side represents the moment of the centripetal forces about the same point. Suppose, now, the parts to be so chosen that the centrifugal force of the weight E, due to increase of speeed, shall be just equal to the decrease of centrifugal force, due to the weight E moving nearer to the center; then

$$Er N^2 F = Er' N'^2 F$$
$$r N^2 = r' N'^2$$
$$r = \frac{N'^2}{N^2} r'$$

Subtract equation (2) from equation (1):

$$WRN^2 Fa - WR'N'^2 Fa = (S - S')b.$$

Equation (3.)

The weight E may evidently be so chosen that in equation (2) the tension of the spring may be zero. That is, the initial tension $S' = 0$.

From equation (3) we then get:

$$S = \frac{a}{b}(WRN^2 F - WR'N'^2 F),$$

which means that the spring has only to take up *the difference* of centrifugal force of the weight W in its inner and outer positions, instead of the *whole* of that force, as in most governors. The spring may therefore be small and short, and still not be strained to such an extent as to fatigue the metal. A common compression spring, such as is in use under cars, has been used, and it is found

simple and effective. If a spring breaks, the engine stops. The initial tension of the spring, which is what supplies the greater part of the centripetal force in most governors, is here replaced by the centrifugal force of the weight E, which force is practically constant within the range of speed variation. It may be urged that the inertia of the weight E will retard the action of the governor, and when it is in motion carry the weight too far, and thus be a detriment. On the other hand, the inertia of E and W tend to prevent the change of position of the parts due to the rapid and great changes of the valve resistance.

The mean value of this valve resistance is practically constant, while the centrifugal forces of W and E change as the square of the revolutions; so that a pound or two increase of these weights increases enormously the strength of the governor to overcome the valve resistance. Heavy weights are therefore an advantage instead of a detriment, as they prevent the valve from controlling the governor by their inertia, and produce a governor strong enough to overcome any valve resistance. Results of practice show some of the best regulations with the initial tension of the spring zero, which corresponds to the greatest value of weight E. It is evident that equation (2) may be satisfied with any values of S and E

from $S = O$ and $E =$ maximum
to $S =$ maximum and $E = O$;

but the smaller E becomes, the larger and longer the spring must be; and it has been found in practice that a sensitive, powerful governor can best be had by giving E a considerable value.

In every centrifugal governor a change of speed is necessary to produce a change of the position of the parts, and of the valve motion. Whether this change of speed be momentary or continued, great or small, it is necessary; and the problem to be solved is how to reduce the change of speed to a minimum and still have a stable governor. In the governor under consideration, the regulation is obtained by heavy weights and light springs arranged in a peculiar manner, with friction reduced to a minimum, in contradistinction to light weights and heavy springs with artificial friction introduced to mollify the evils of real friction. As applied to a 9½x12 engine, with piston valve, some of the data are as follows:—suppose

Maximum revolutions	$N =$	303
Minimum revolutions	$N' =$	300
Variation of revolutions		1%
Valve resistance varies from 0 to 20 lbs., mean value	$V =$	10
Initial tension of spring	$S =$	0
Moment of centrifugal force of W at N revolution	=	2930
Same at N' revolution	=	1850
Increase of moment of W for 1% variation of speed	=	1080
Percentage of increase	=	58%
Moment of valve resistance	=	12.5
Ratio of valve resistance to increase of moment W		$\frac{12.5}{1080} = 0.0116 = 1.16\%$
Maximum tension of spring	$S =$	470 lbs.
Compression of spring	=	1 inch
Moment of centrifugal force of E at N revolution	=	1744
Same at N' revolution	=	1831
Difference of moments of E	=	93

If parts had been so chosen as to make this difference $= O$, the maximum spring tension would have been $S = 432$ lbs. Note that the moment of the valve resistance is very small compared to the moment of the centrifugal force of the flying weight—that is, about 0.4 per cent., or 1.16 per cent. of the difference of this moment of the flying weight for a variation of speed of 1 per cent. The valve motion permits a variation of cut-off of from 0 to 0.7 of the stroke. A variation of speed of less than 1 per cent. between no load and 0.7 cut-off may be readily obtained in practice, and this regulation can be maintained during long-continued runs When this governor is applied to center-crank engines with valve connections outside of the fly-wheel, as is becoming quite popular, the eccentric can be dispensed with, and replaced by a wrist-pin D formed on the end of an arm extending from the cross-arm d, as shown in dotted lines to the left of the lower figure. This will do away with the annoyance generally attending the use of eccentrics.

In the discussion which followed the presentation of this paper, Mr. E. J. Armstrong said:

The first proposition of this paper is, "A governor, to be sensitive, must be free from friction." It is perhaps an act of temerity to question this statement, which has almost passed into an axiom among engine builders, but as the writer has in another paper made mention of good effects from a small amount of governor friction, a statement of reasons for that belief may be in order.

In several experiments made by the writer some time ago, to find out how much better governing might be obtained by the use of anti-friction devices, the result was not at all as was expected. The governors became less steady, and in order to work as satisfactorily as before, had to have the initial tension of spring reduced so as to govern less closely; apparently showing that the small amount of friction originally present was an element of stability, and acted to prevent too rapid, and consequently too great changes in the position of the fly-weights. The valve resistance changes the direction so rapidly, that in a reasonably heavy governor, the inertia is sufficient to prevent any serious disturbance of the governor system by it. But, unless the governor friction is greater than the valve resistance, it would seem that there must be some vibratory movement caused. If a change in the engine speed occurs, acting to change the position of the fly-weights, the amount is aided half the time by the valve resistance, and half the time opposed by it; the sum of the two forces will move the fly-weights much further than their difference will, consequently, the fly-weight will hitch along until the changed position of the valve again permits a balance of the centrifugal and centripetal forces. This is offered rather as a theory than as a statement, the experiments referred to not having been carried far enough to prove that this action actually takes place; only to suggest it as a probable explanation of the behavior of the governor experimented with, and of the thousands of governors successfully running, in which the governor friction is greater than the difference in centrifugal force, due to the change in speed when the load is varied.

In the paper under discussion, mention is made of the centrifugal force of the weight, acting in lieu of the initial tension of a spring. Now, the use of a spring in a fly-wheel governor is to furnish a resistance constant for any given position, to the centrifugal force of the fly-weight, which varies with every change of speed, in order that, when a change of speed comes, the difference between the constant and inconstant forces may act to change the position of the governor system.

On page 6 of Mr. Smith's paper he says: "Results of practice show some of the best regulations with the initial tension of the spring zero," which means that for one position of the governor, the spring has no strain upon it, and that the entire centrifugal force of the fly-weight is opposed by the centrifugal force of another fly-weight. For that particular position of the fly-weight, there can be no difference caused by speed between the two forces in equilibrium. If they will balance each other at one speed, they will do so at any other, and it is hard to understand how any governing can be obtained under the conditions; for any other positions of the governor, the conditions are different. The fly-weight W has moved away from the shaft, and the weight E has been drawn close, so that W has a greater centrifugal value than E, the difference at the speed desired for the governor being supplied by the spring, which is now under tension; when a change of speed occurs, the force acting to move the governor is the difference in centrifugal force, which would be caused by the change in speed; for a fly-weight having a centrifugal value equal to the difference between W and E, an amount which would seem rather small for quick governing, and liable to make sluggish action of the governor, with a considerable less value for E, the force acting to move the fly-weight when a change of speed occurs, becomes greater, and the governor becomes of greater power and stability, capable as it has proved itself of successful governing under the most exacting conditions. It may put the whole problem in a clearer light to say, that for any given position, the governor, so far as governing is concerned, is the same as it would be if the fly-weight only had a centrifugal value equal to the difference between W and E, and the remainder of the weights were replaced by one of equal inertia divided between the eccentric and its fly-weight. Only an amount of fly-weight which would balance the spring can be taken as having anything to do with shifting the eccentric, and this amount varies with the position of the fly-weights; the remainder of the weight is simply inertia weight.

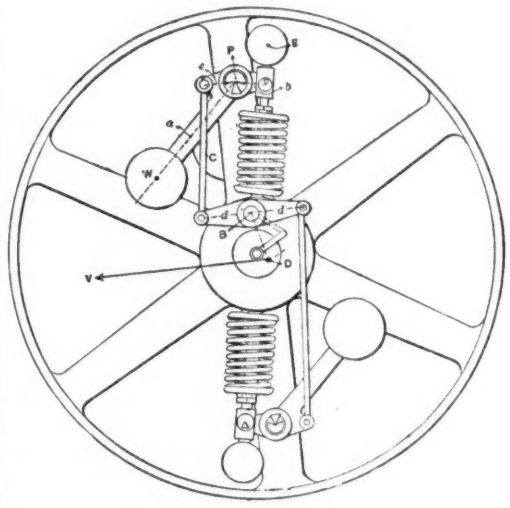

FIG 151.

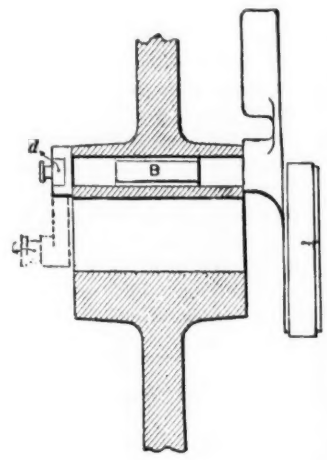

FIG. 152.

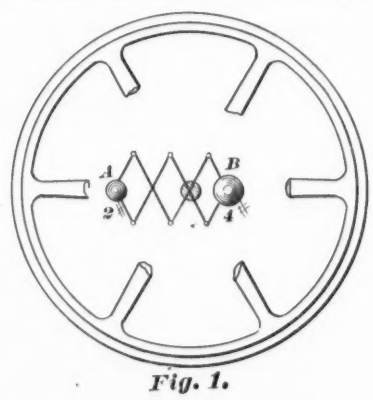

Fig. 1.

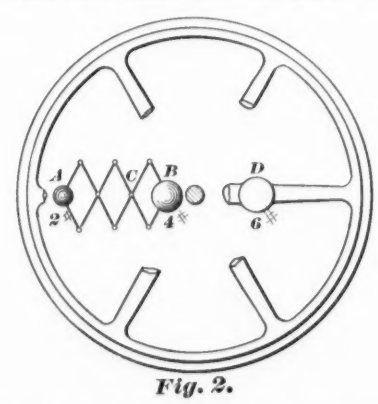

Fig. 2.

Prof. John E. Sweet, who had intended to be present at the meeting, was detained at home, and his discussion of this paper was accordingly presented by the secretary. The diagrams and description were not presented at the meeting, but have been furnished us by Mr. Sweet in order to make the discussion complete, it having been his intention to give them at the meeting by aid of the blackboard, had he been present. His complete discussion therefore is as follows:

The author of the paper, in his third proposition: says, "In order that the shaft may not be thrown out of balance by change of position of the governor weights, these weights must be symmetrical."

It so happens that this statement is not true. In a single-ball governor, if the weight of the eccentric and its attachments balance the governor ball, and moves in the opposite direction on a line through the center of shaft, it will balance it in all positions.

Even if this were not true, in the single-cylinder engine the unbalanced weight of the reciprocating parts exceeds the weight of the governor ball, as perhaps ten to one, so that—with the unbalanced single ball at its worst, it would be unnoticable, in the engine

If the weights shown at A and B, Fig. 1, be coupled by the lazy tongs arrangement, it goes without saying that they will balance in all positions, and that the center of gravity of the system is in the center of the shaft.

In Fig. 2 the same system is moved to one side of the shaft, and the center of gravity is at C, no matter to what extent the balls A and B are moved.

Then, if a counter weight be placed in the wheel at D, the wheel will not be thrown out of balance by any shifting of the governing weight A, and that holds good, even if the weights A and B do not move on a radial line, provided they move in opposite directions.

If the above be true, then Mr. Smith's third proposition cannot be correct.

As direct evidence, we run the single-ball governed engine at all speeds while resting on a greased iron plate without any fastenings whatever, and without any evidence that the single ball disturbs the balance.

I am unable to understand, and hence unable to refute Mr. Smith's mathematics, but in one at least of his conclusions I am confident he is in error.

If the weight shown at E in his drawing has sufficient centrifugal force to resist the centrifugal force of the weight W, at 25 revolutions, it will do so at 250 or any other number of revolutions. So that it hardly seems true that the governor can be made to work without more or less initial tension on the springs, nor does it seem as if there would be any great gain in doing so, if it could.

Were all the balls concentrated in one, its inertia would be equally efficacious in resisting the disturbing influence due to friction of valve. And as the one weight would have a greater range of motion than the average of the four, likely it would be more serviceable than in the form shown.

The best part of the paper is the statement "that the governor works well," which I am ready to believe, if the weight E is small enough, as I am that there are others that work well also with less pieces.

Prof. R. H. Thurston's discussion (which was also presented by the secretary) was as follows:

I am much interested in the paper and the new form of governor which it describes, and would be glad to get more particulars of its performance, especially as to the manner in which it meets those sudden variations of load often met with, especially in electric lighting, those which take place in an instant, and without preliminary fluctuations. The principles enunciated in the introduction to the paper are well stated, and it is to meet the requirements thus formulated, that inventors of governors have been seeking new and more perfect devices, from the days of Sickels' and Corliss' inventions, and especially since the demands of the finer textile manufactures and of electrical work have become so exacting.

I would add one more to the list, and say:

Fifth.—That the governor may act not only promptly and powerfully, but with accuracy, it must include some adjustment or some special mechanism that shall insure the quick movement of its parts into the required position, to give equilibrium between driving power and load, between effort and resistance, instant by instant, and thus evade the ill effect of inertia in throwing the governor beyond the right point at each sudden change.

There are, I think, two ways in which this result may be attained: The use of a dash-pot, offering rapidly augmented resistance with increasing velocity of displacement, while allowing moderate rates of movement without appreciable impediment, is a familiar method of meeting this demand, one which has been long in use in nearly all classes of construction. In some cases I think it may be found that the regulation of the exaggerating action of inertia is effected by the friction of the valve motion itself; which pins the mechanism fast at certain points in each revolution, and compels the exact adjustment of the steam distribution to but a limited extent in each of several revolutions. How far this may prove useful or desirable action it is impossible at present to say. It would be an interesting matter for investigation.

In the form of governing which is here described I see what appears to me a very interesting and probably useful arrangement, which, whether so intended or not, will perhaps prove to give a similar effect. The weight *W* is so suspended that any quick movement of the engine will jerk the wheel ahead or back, accordingly as the load is dropped off or thrown on, in such manner as to produce, in consequence of the inertia of the weight, a relative motion of *W* and the other parts of the governor, which must result in quick closing or quick opening, as the case may be, so as to the more promptly meet the tendency to acceleration by a responsive action of the valve-motion. The substitution of knife-edges for pins and joints of the usual sort is obviously an important modification in the direction of improvement, and especially as insuring a constant and permanent sensitiveness. It is unquestionably very desirable to dispense with all lubricated joints in any governor of this class. It is in these directions that Professor Sweet has been so long and so successfully working; and with this end in view we have just attached to the first of the straight-line engines, that built in the Sibley College shops of Cornell University, a governor designed by Mr. E. S. Bowen, of the University, which is without joint, and absolutely frictionless. It has proved to be most satisfactory; the steam distribution and the regulation have been found all that could be desired, and more than would usually be expected of any governor of any one of the older forms. Nevertheless, where provision is made for steady and sure lubrication, the action of the original Hartwell governor, or of any of its better class of successors, can usually be made more accurate than any of the Watt governors. I should expect thoroughly good work from the governor here described.

There was some further discussion of the paper, some of it illustrated by blackboard sketches, and the author, in closing, said that there were of course many points which must be finally settled by the results of actual practice, some of them being of such a nature as to make their determination by calculation impracticable.

Railways Entitled to Some Gratitude.

The liabilities of the railroad system of this country are $10,000,000,000. They paid out in dividends $1,000,000,000 last year. They carry annually one-half a billion of passengers with a very small percentage of accidents. They have increased their facilities at a ratio one-third greater than the increase of population. More than one-tenth of the entire population of the country live directly or indirectly by railroads, yet, in spite of these facts, which cannot be contravened, there is ever to be found rampant antagonism to railway interests. In New Orleans the antagonism amounts to folly. One does not require to be a political economist to arrive at the conclusion that the benefits this city receive directly or indirectly from the several lines of road running into it are indeed very great.

The idea has been deep sown and taken good root that railroad companies are the legitimate prey of any one who can make them disgorge. When an untoward accident occurs that is detrimental to a railroad company's interest, such as was that which occurred on the Illinois Central line, whereby its travel has been stayed, instead of awakening public sympathy and regret, a feeling seems to be prevalent that no evil could be too great that would lessen the dividends. But of course they are not stockholders who harbor such feelings. It cannot be denied that the several railroad companies, whose roads run through the sections of country that has either been inundated or threatened by that dire misfortune, have done all in their power to counteract the ravages of the flood. The work performed by the Illinois Central Company and the Mississippi Valley Company has been of a nature so gigantic as to almost exceed belief. The companies not only recognized the fact that they had the selfish mode of guarding their property from total destruction, but also were aware that they are, in the true sense of the term, the public's servants, and that, being so, it was incumbent on them to do all they could to give their masters good service by not permitting transit to be hindered. To that end the companies not only labored to secure their lines from destruction, but also when a stoppage occurred at once formulated plans by which the public's convenience was not one bit retarded, either in personal travel or in the transportation of merchandise. The railroad companies are only the public's servants—they fully recognize that fact, and are willing to do servants' work. Both servants and slaves have rights—and surely one of those rights is respect. The officials of the several companies whose termini are in New Orleans, from the president down to the man holding the most subordinate position, are worthy of our respect, for they at all times are willing and anxious to do what they can to promote the comfort of and to evince courtesy to their patrons—the general public. No better proof of this statement could possibly be adduced than what occurred recently, when the excursion train on the Illinois Central was belated at Manchac. The officials of the road at once did all in their power to assist the excursionists, supplying those short of money with that necessary evil, and doing everything that could be thought of to promote the comfort of the travelers and assuage their anxiety. Certainly it was their duty to do so. It is pleasing to think that there were those who recognized the railroad officials' desire to serve them, as the letter of thanks published in the papers showed. The public did doubtless suffer inconvenience—great inconvenience—but the railroad company was not to blame. The misadventure was caused by Him who is more powerful than all the railroad corporations on earth.—*New Orleans Evening News.*

Personal.

Mr. F. G. Tallman, for the past six years superintendent of the Beaver Falls Mills, of Carnegie, Phipps & Company, Limited, formerly the Hartman Steel Company Limited, has resigned his position to take effect June 1st.

It is said that water-works in the United States and Canada have about trebled in the last ten years, growing from 660 in 1881 to 1,900 to-day. The capital invested is $500,000,000, their annual revenue is $50,000,000, their mains are 30,000 miles long, and they have 2,000,000 taps.

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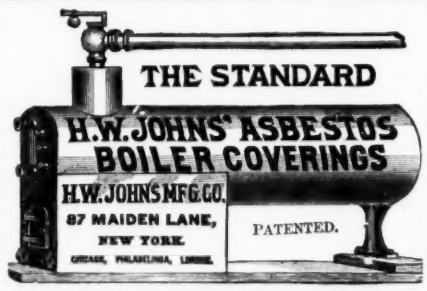

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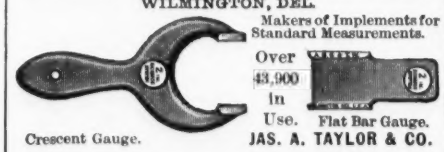
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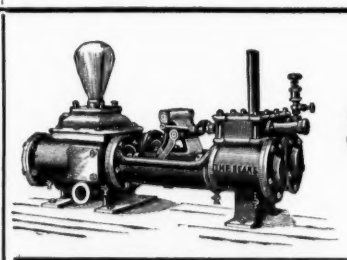

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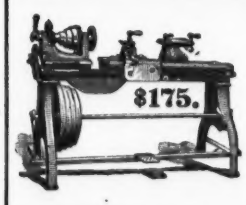

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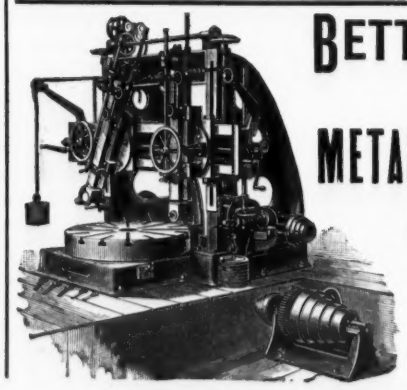

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Locomotive, Bridge and Engine Builders, Railroad, Car and Machine Shops
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Iron and Steel Works Generally.

There is about one-half as much money invested in building and loan associations in the State of New Jersey as there is in saving banks, and the difference is constantly growing less.

The French Chamber has just passed a bill imposing three months' imprisonment on any master, overseer or workman who, by threats of dismissal or refusal of services on the ground of connection with a trade union, interferes with the liberty of the subject.

An American inventor has been busy over the horse collar fastener. This is an improvement in fastenings to be applied to horse collars which open at their lower ends, and consists in the novel construction and arrangement of two metal plates adapted to be applied to collars of any size, to form an easily operated and efficient locking device.—*Invention.*

Well, when a whole harness fastening is so easily operated that the horses can get into place and a fire engine be ready for the road in five seconds, what chance does an inventor stand? He ought to tackle some "long-felt want."

Machinists' Supplies and Iron.

NEW YORK, June 7, 1890.

Iron—American Pig—The Thomas Iron Co. has notified its customers of a reduction on all deliveries made after June 1st to a basis of $18 for No. 1 Foundry, and $17 for No. 2. Consumers continue to buy in a moderate way, and only in such amounts as are needed for current use, though the production of well-known furnaces is mostly absorbed by deliveries on contracts.

We quote Northern brands No. 1 Foundry, $17.50 to $18.50; No. 2, $17 to $17.25. Southern brands No. 1, $16.50 to $17; No. 2, $16 to $16.25.

Scotch Pig—The demand has been slow and for small lots.

We quote Eglinton, $19 to $19.50; Dalmellington, $21.25 to $21.50; Coltness, $24.50 to $25.

Bar—The demand has been fair during the week, but prices rule in buyers' favor.

We quote Common, $1.85; Medium, $1.90; Refined, $1.95 to $2, round lots on dock.

Copper—No large transactions are reported, those going on being simply to cover immediate wants.

We quote Ingot Cakes and Wire Bars at 14⅜c. to 14½c. Common casting brands are somewhat easier, at 12¾c. to 12⅞c.

Lead—The market has ruled quiet, with little speculative interest. Prices rule at 4¼c. to 4.35c.

Spelter—The demand has been moderate. Prime brands are quoted at 5¼c.; Choice, 5⅜c.

We quote Ordinary brands of Western, 5.45c. to 5.50c.; Choice, 5⅝c. to 5¾c.; Refined, 6¾c. to 7c.; Silesian, 6¾c. to 7c.

Tin—There has been an advance in London, which has caused prices to rise somewhat here, and had the effect of checking the jobbing demand. Prices have ruled at 21.40c. to 21.70c.

Antimony—There has been a moderate jobbing demand, quotations being for Hallett's, 19c. to 19¼c.; Cookson's, 25c. to 26c.

Lard Oil—The ruling price is 53c. for Prime.

WANTED

"Situation and Help" Advertisements only inserted under this head. Rate 30 cents a line for each insertion. About seven words make a line. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue.

Mech. draftsman desires situation. O.B., AM. MACH.

Situation wanted by an exp'd mechanical draftsman, graduated in Sweden. "Good," AM. MACH.

Wanted—Position as sup't or foreman of machine shop. First-class refs. Box 25, AMERICAN MACHINIST.

Wanted—A first-class pattern maker. Steady work and good pay to the right man. Address Box 16, AMERICAN MACHINIST.

Foreman wanted to take charge of a machine shop; competent to manage men, and exp'd in steam engine building. Address N. M., AMERICAN MACHINIST.

Pattern Maker—first-class—wants a situation to have charge. 16 years' experience; age, 32; one year as foreman. Box 23, AMERICAN MACHINIST.

Wanted—At once; first-class draftsman. Address, with full particulars, The Shaw Electric Crane Co., Milwaukee, Wis.

Wanted—A first-class pattern maker; one acquainted with saw-mill machinery. Address D. J. Murray Mfg. Co., Wausau, Wis.

Wanted—Position by practical draftsman and machinist, 25, technical education. N. Y. City or vicinity. M., AMERICAN MACHINIST.

Wanted—A few first-class machinists. State experience, age, habits, etc., and give reference. The Canton Steam Pump Co., Canton, O.

Wanted—Six first-class machinists and two pattern makers; steady work. Rents and living cheap. Address Haxtun Steam Heater Co., Kewanee, Ill.

Wanted—Draftsman; one accustomed to general machinery and millwright work preferred. State exp., wages wanted, etc. W., AM. MACHINIST.

Wanted—A first-class foreman to take charge of about 40 men building iron working machinery. Address BOX 28, AMERICAN MACHINIST.

Wanted—Mechanical drawing to do at home. Address E. E. O'Daniels, with Geo. H. Eaton & Co., Sta. 14, Mt. Washington ave., Boston, Mass.

Experienced mechanical draftsman, age 25, technical school graduate, wishes situation. New York or vicinity preferred. Box 27, AMERICAN MACHINIST.

Wanted—A draftsman familiar with steam boiler, engine, heating and ventilating work. Address, stating exp., refs., and compensation exp'd. Box 26, AMERICAN MACHINIST.

Wanted—At once; two first-class wood pattern makers. Apply by letter, stating age, experience, and wages expected, to T. H. E. Co., Lynn, Mass.

Wanted—Several first-class machinists for lathe and plane work. Steady employment to reliable men. Apply, with references, to the Westinghouse Machine Company, Pittsburgh, Pa.

Machinists Wanted—First-class floor hands and fitters of large experience and of good habits can find steady employment and liberal wages. Address Morgan Engineering Company, Alliance, O.

Draftsman Wanted—Presses, dies and general machinery. Write, stating age, where last employed, and salary expected, to the Dover Machine Works, Dover, Delaware.

Wanted—Foreman for small brass foundry within 150 miles of Chicago. One used to getting out first-class snap flask and moulding machine work. State age, experience and salary expected. Apply to C. S. H., AMERICAN MACHINIST.

Wanted—Mechanical draftsman as ass't on metal-working machinery; one with technical education and one or two years' practical experience. Steady work and good pay to competent man. Fitchburg Machine Works, Fitchburg, Mass.

Wanted—A 1st-class moulder for a small foundry; principally on engine work. Must be able to handle a few men and push things. To an intelligent young man of good character this is a good opening. Address "Pennsylvania," AMERICAN MACHINIST.

Wanted—Position as sup't or foreman by a young man, 35, successful in the systematic manufacture of machinery and mechanical devices, and in the economical management of men. A draftsman and designer of automatic and interchangeable machinery, tools, jigs, etc. Box 14, AMERICAN MACHINIST.

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Advertisements will be inserted under this head at 35 cents per line, each insertion.

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Pulsometer Pumps, 2nd-hand, in good order; very cheap. Maslins, 165 First street, Jersey City, N. J.

Engineers wanted to send their addresses and receive free a 25 cent book, "Hints and Suggestions for Steam Users." Lord & Co., P. O. Box 1262, Phila., Pa.

Wanted—In a well-equipped machine shop, job work or some light machinery to build. Address A. H. Anthony, Jewett City, Ct.

Wood-working machine and a few specialties suitable for shafting and steam fitting trade to be had on royalty. Box A, AMERICAN MACHINIST.

Wanted—To buy second-hand lathes, planers and shapers of all sizes. Must be cheap and in good order. Fosdick & Plucker, 6th and Culvert Streets, Cincinnati, O.

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For Sale—A first-class small machine shop in Ohio. Large business on engines, etc. On leased ground. Will sell at a bargain on long time if sold at once. Ill health cause of selling. Address E. E., South Oil City, Pa.

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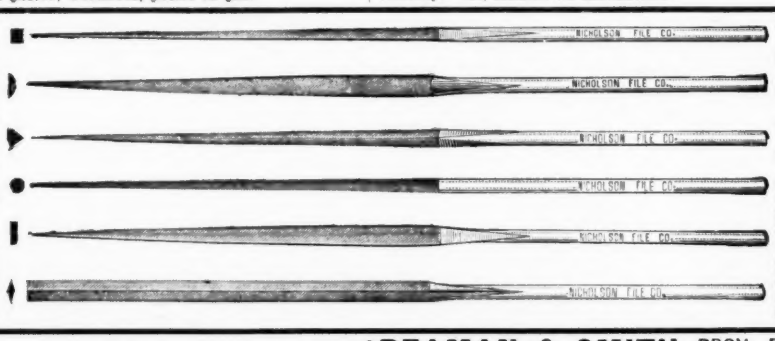

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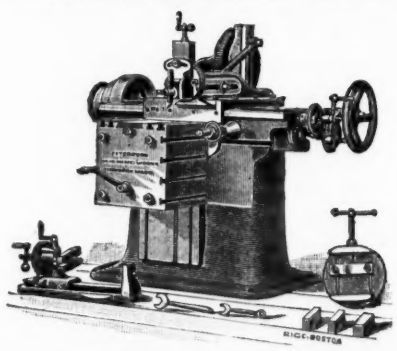

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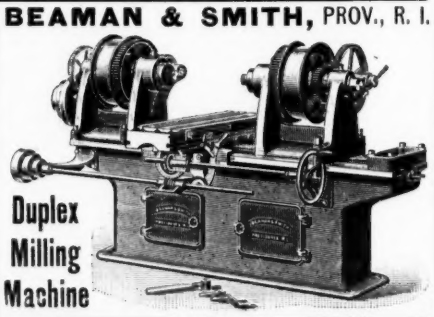

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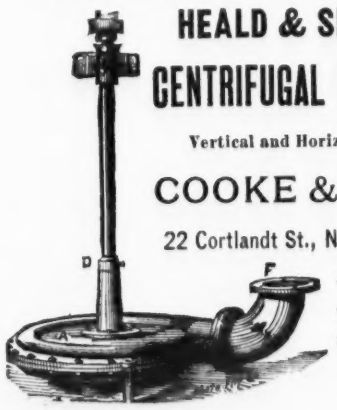

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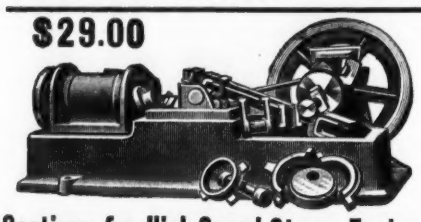

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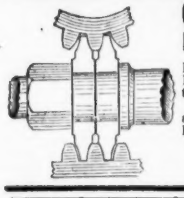

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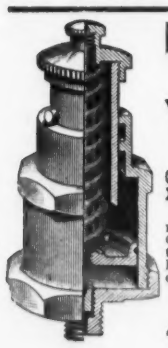

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1886.

Pattern Making, Various Articles on. By F. W. Barrows. Appearing in 29 issues.
Foundry Practice, Various Articles on. By Robt. E. Masters, appearing in 16 issues.
Strength of Different Mixtures of Cast-iron and Method of Testing. By Robt. E. Masters, April 24.
Foundry Practice, Articles on. By Foundryman. [L. C. Jewett.] Aug. 14, Sept. 25, Dec 18.
Foundry Practice, Articles on. By S. Bolland, May 8, 22, 29, June 26, July 10.
The Morton-Poole Roll Grinding Lathe. By Joshua Rose, J. G. Tramis, Geo. H. Babcock and C. A. Smith, July 3, 24, Aug. 7, 14, 21, Sept. 25.
Machine Shop Cost and Time Accounts. By A. J. Shaw, Henry Metcalfe and C. A. Burton, April 3, 17, May 8.
Tests of Iron. By David Spence, April 17, Oct. 30
Traction on Grades. By A. B. Ropes, Oct. 30.
Wilson's Valve Gear for Locomotives. Oct. 30.
Casting Face-plates Face Up. By David Spence, Oct. 23.
A Job of Shaft Straightening. By F. L. Johnson, Oct. 23.
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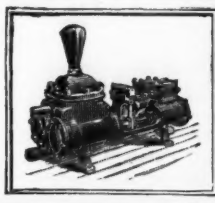

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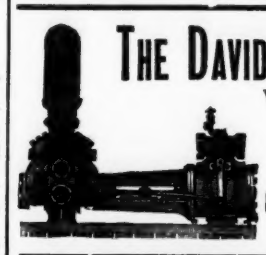

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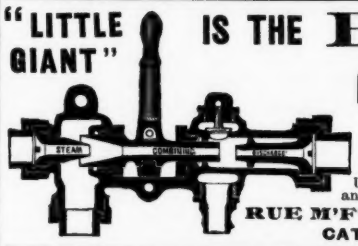

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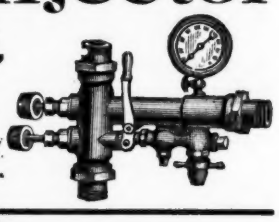

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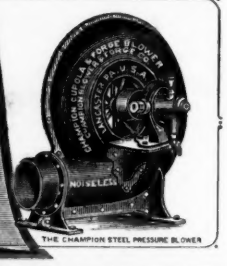

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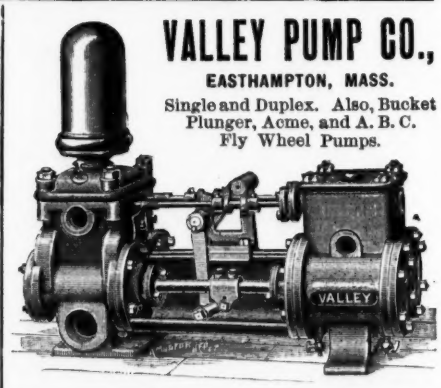

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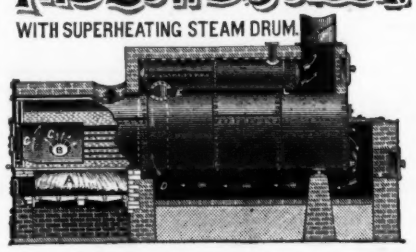

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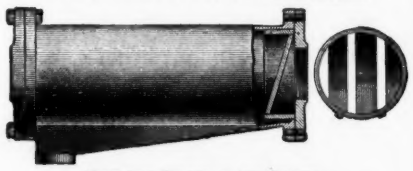

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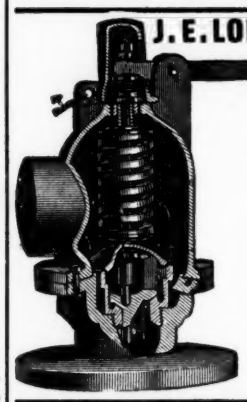

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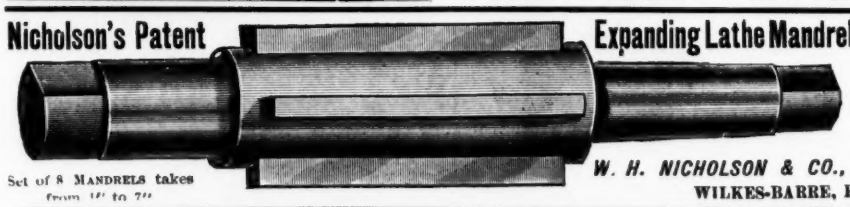

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24 in.	30 in.
30 in.	36 in.
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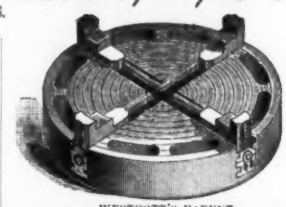

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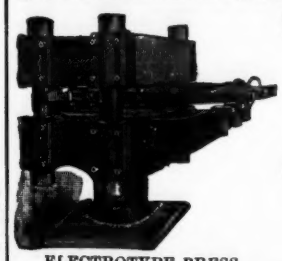

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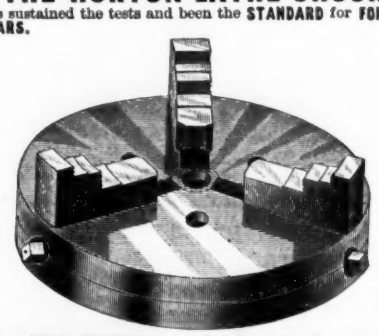

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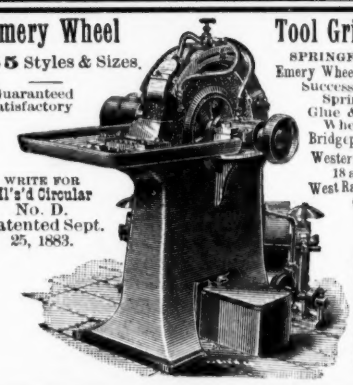

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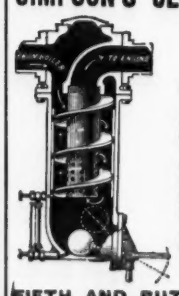

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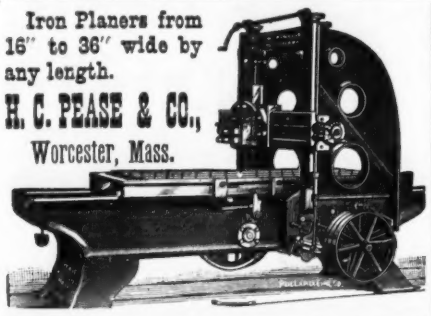

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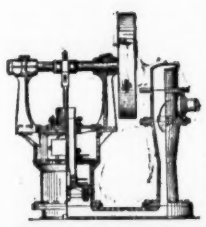

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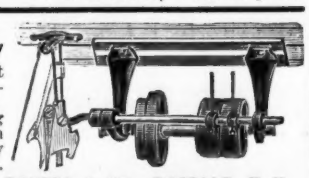

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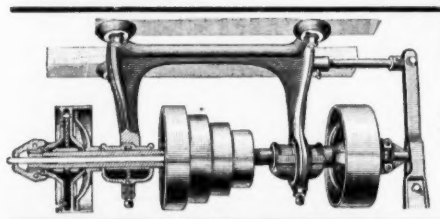

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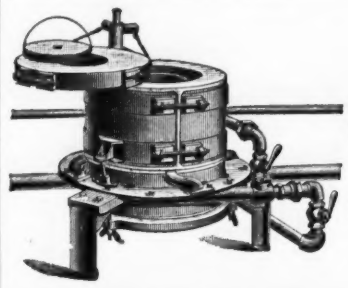

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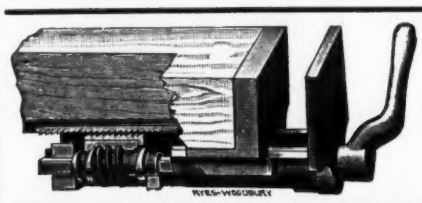

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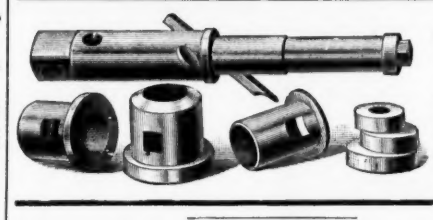

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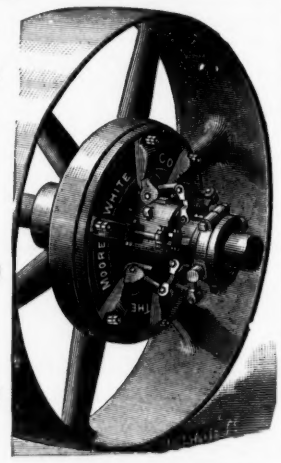

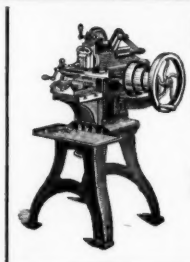

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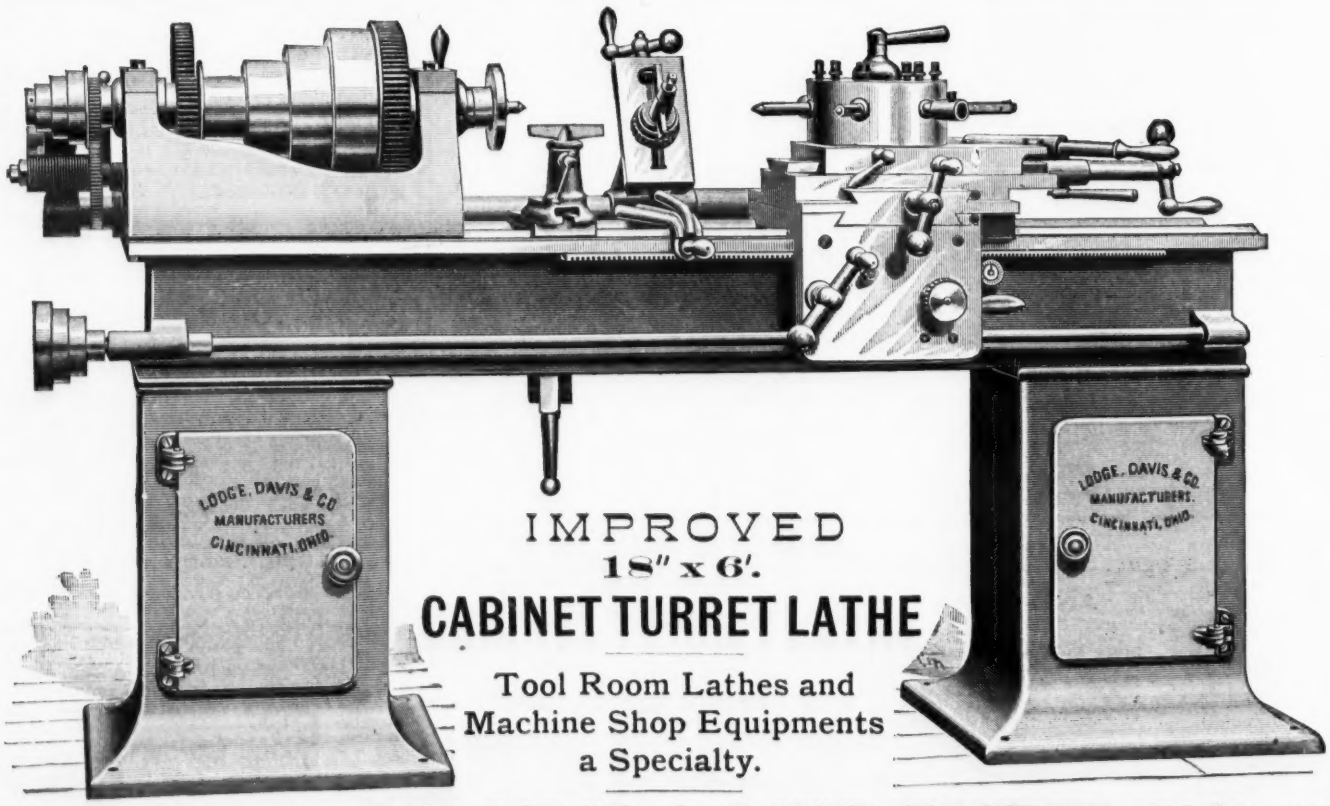

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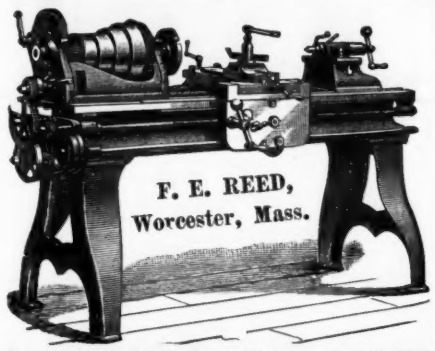

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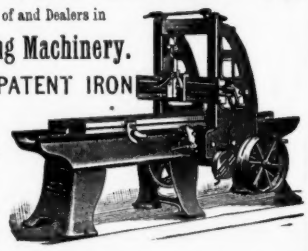

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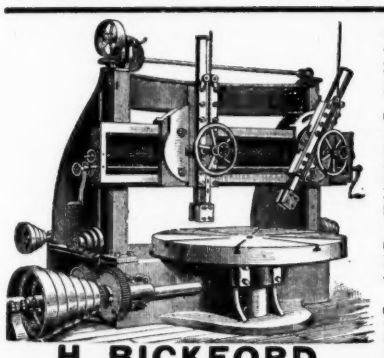

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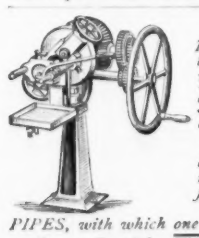

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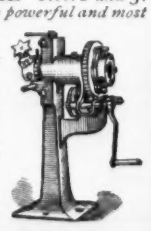

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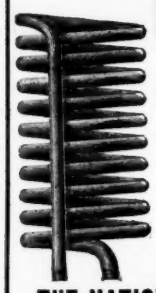

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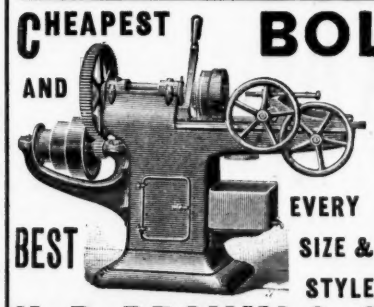

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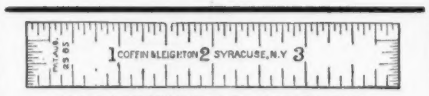

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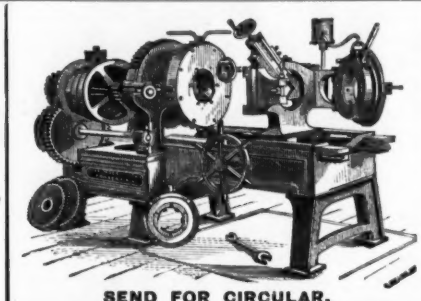

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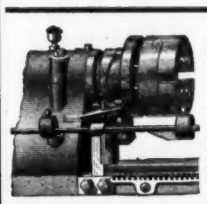

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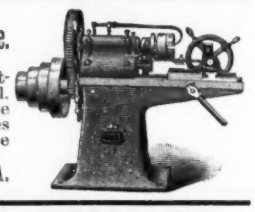

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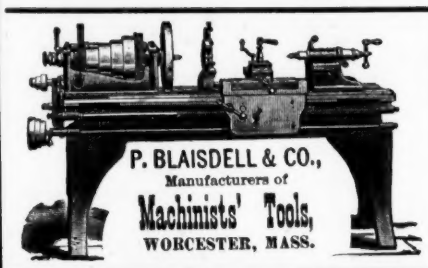

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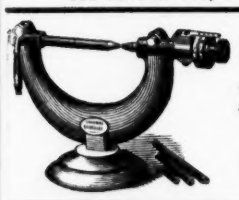

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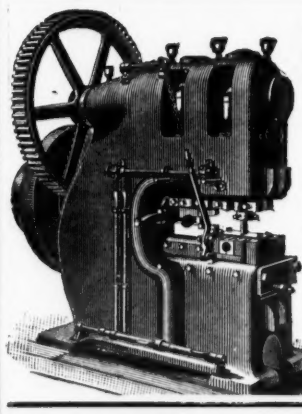

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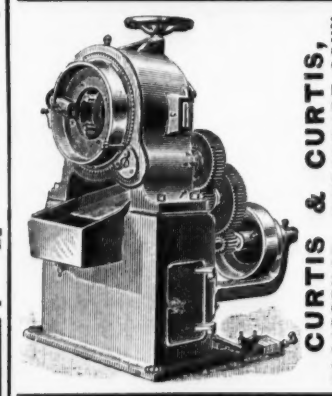

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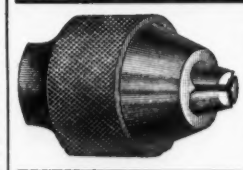

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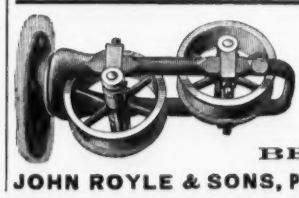

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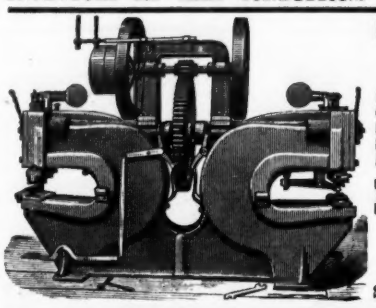

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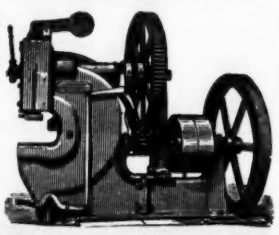

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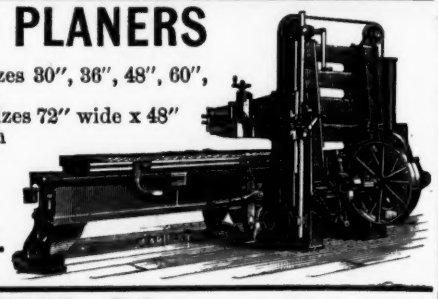

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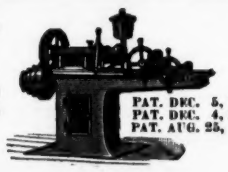

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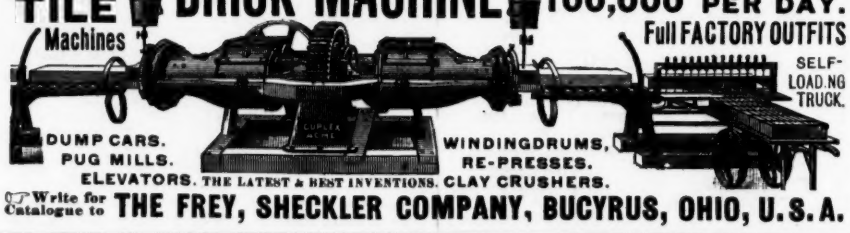

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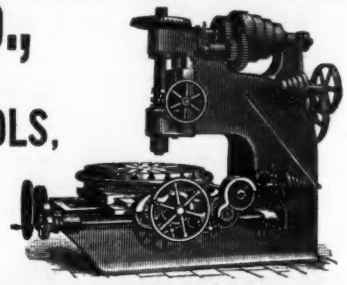

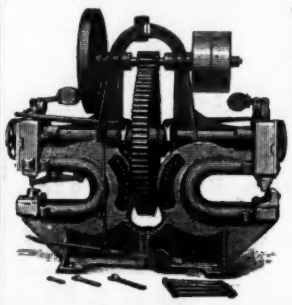

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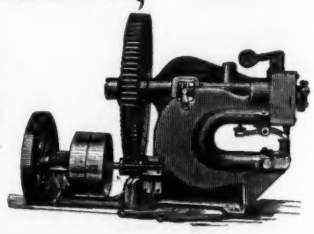

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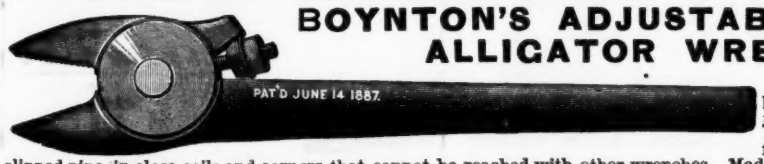

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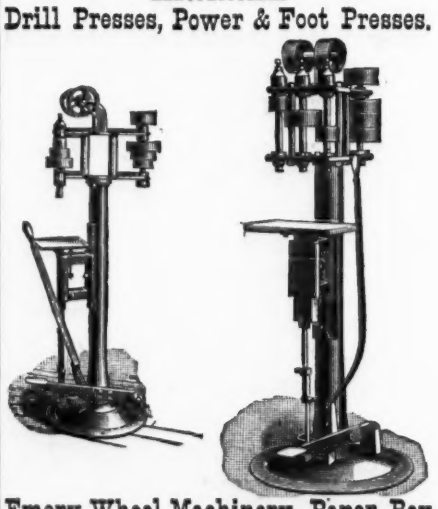

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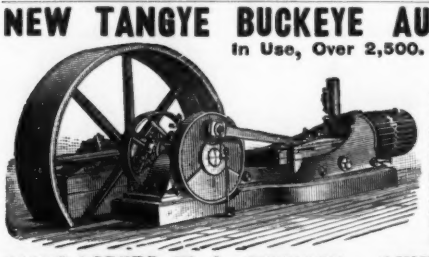

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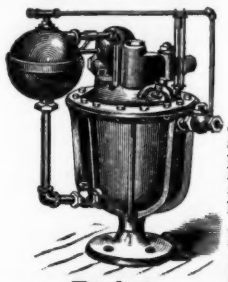

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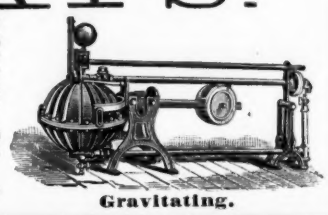

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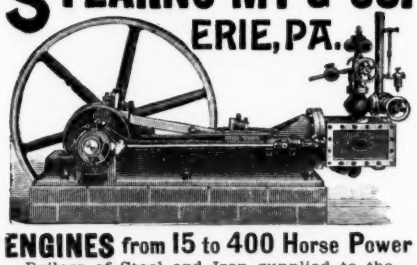

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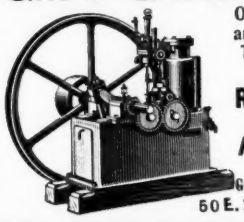

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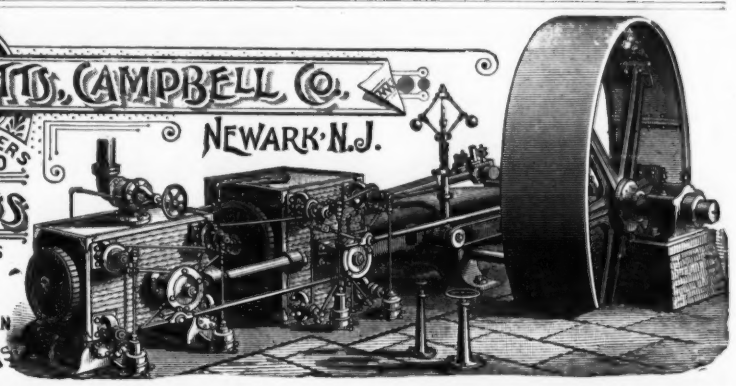

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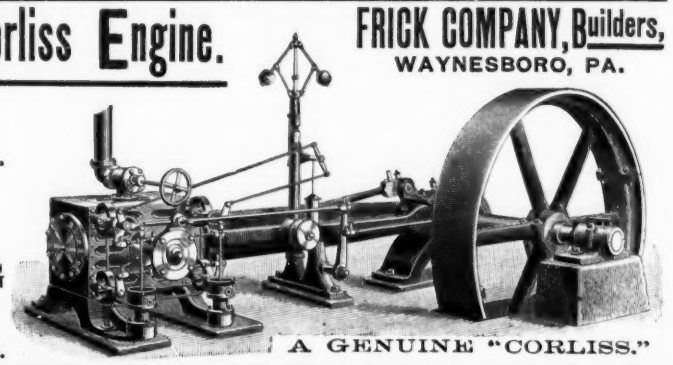

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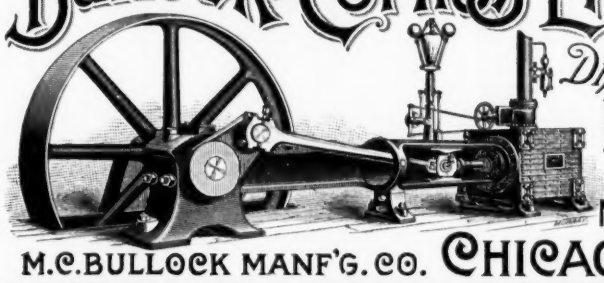

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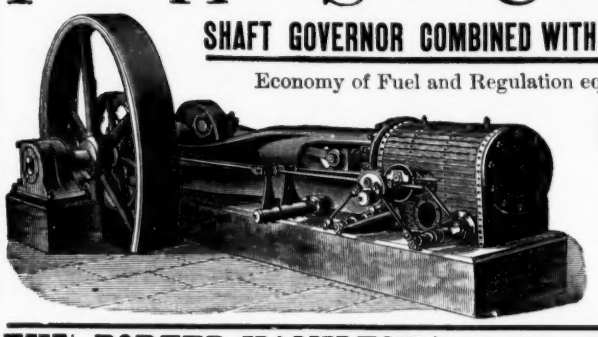

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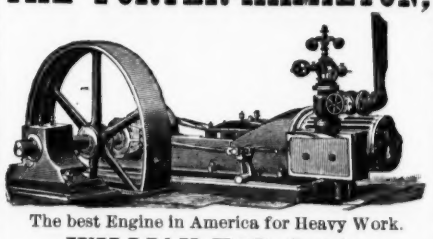

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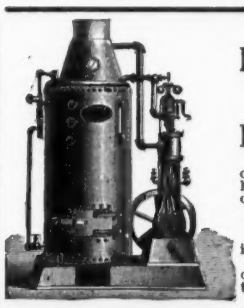

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In order to close out the remainder of the stock, offer for sale

A Very Desirable Lot of Machinery,

such as lathes from 15″ to 88″ swing, planing machines 48″x45″x10′, 53″x50″x12′, 17″x14″x24′, 72″x69″x24′, and various other sizes; drilling machines, slotting machines, shaping machines, boring machines, bolt-cutting machines, cutting-off machines, nut tappers, milling machines, gear cutters, emery tool grinders, portable drills, screw-cutting machines, vises, lathe and planer tools, and a variety of small tools; also traveling and jib cranes.

Punching and shearing machines, for boiler makers, with a general outfit of small tools. Blacksmiths' tools, such as anvils, sledges, tongs, etc. Pattern lathes, benches, saws, screws, nails and a general supply of small tools. Foundry cranes, cupolas and small tools. Blocks, ropes, bolts, nuts, washers, packings, pipe and fittings, iron and brass valves. Boiler iron, steel plate and boiler rivets. Bar iron and steel, also steam hammers, and two 8″x16″ and one 10″x20″ Rider cut-off engines.

BALL AUTOMATIC CUT-OFF ENGINES,

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The characteristics of these Engines are Beauty of Design, Superior Finish, Limited Feet in Space required, Economy of Fuel, Perfection of Regulation.

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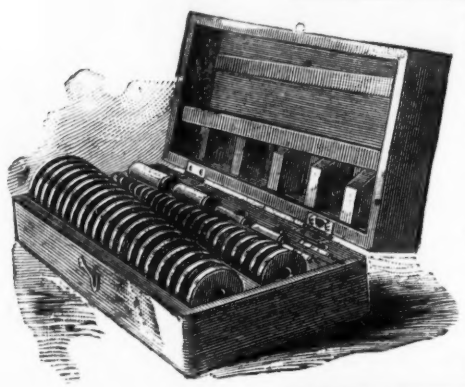

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They are made of steel, hardened and accurately ground to size.

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Car Wheel and Axle Machinery. Double Axle Lathes. Single Axle Lathes. Axle Cutting-off and Centering Machines. Car Wheel Boring Machines. Hydrostatic Wheel Presses. Car Wheel Turning Lathe.

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Every valve tested and warranted, all parts interchangeable.
Nothing but best Steam Metal used in the manufacture.
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The only one built on correct principles.
More economical than any we have ever used.
Can do double the work. Most convenient.
Best in the market. Much admired.
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Could not ask for anything better.
There may be as good a one made by some one else, but I have not seen it.
I feel that I did wisely in buying your tool.
We consider it a model tool and fills the whole bill.

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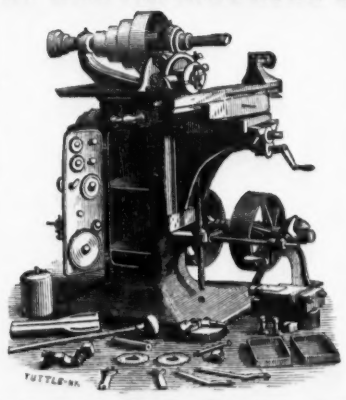

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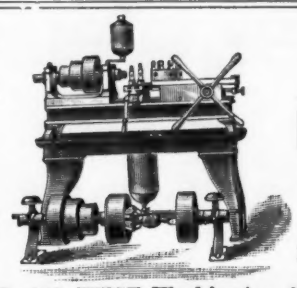

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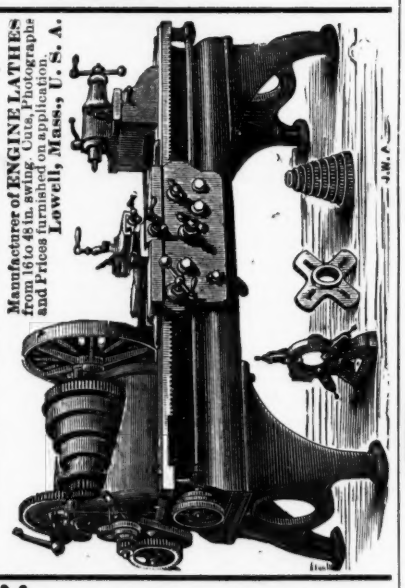

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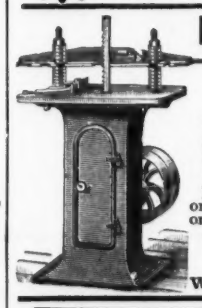

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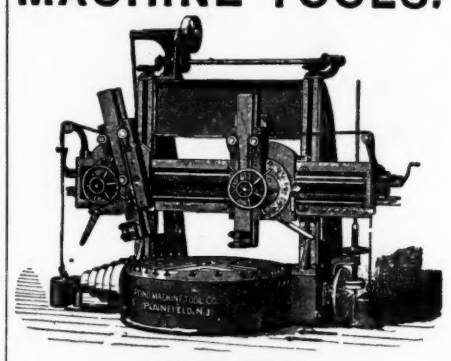

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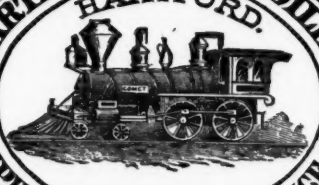

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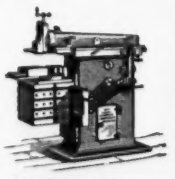

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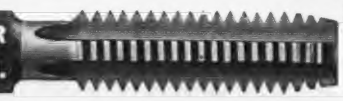

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